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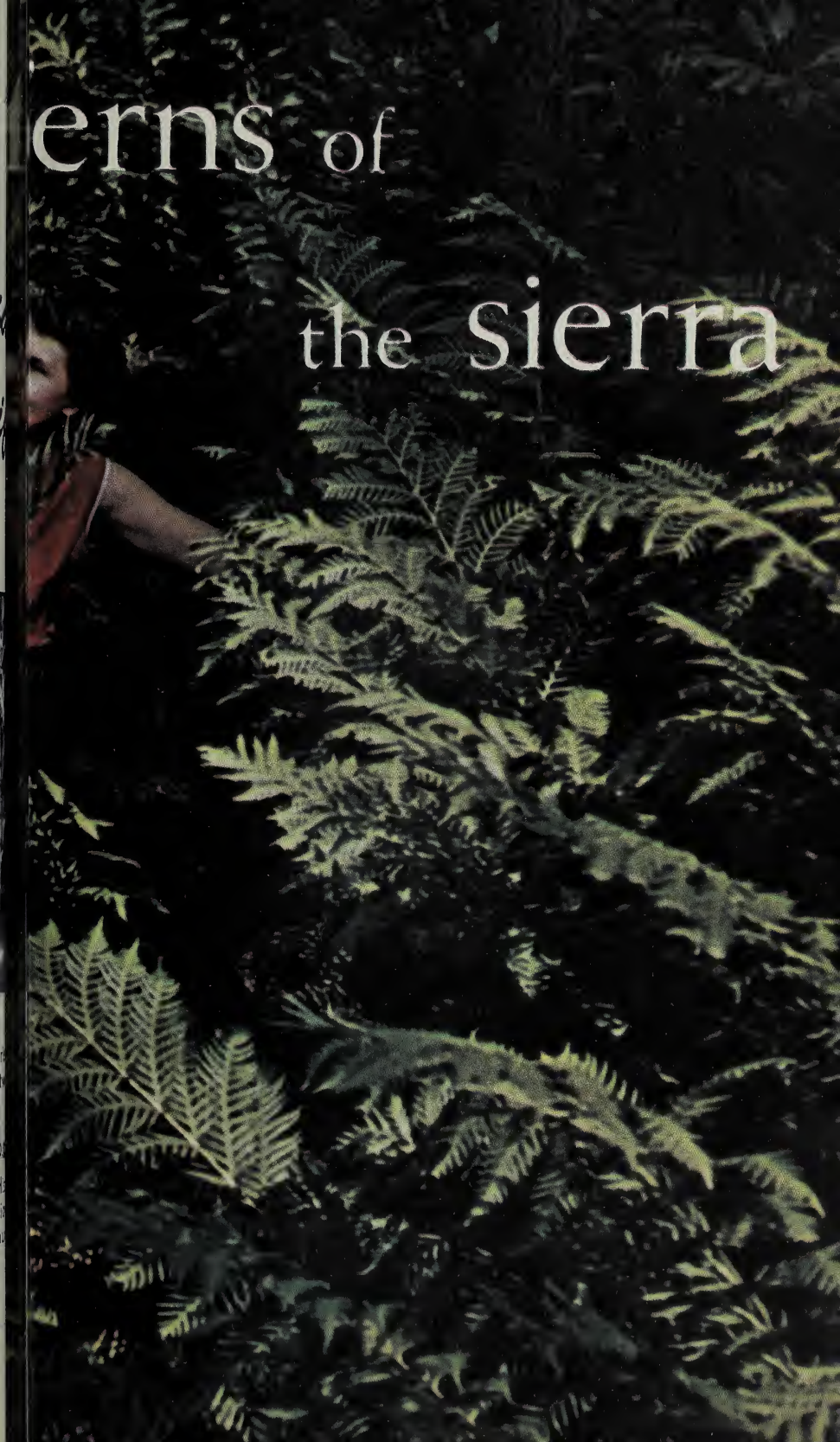
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erns of
the sierra




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# erns of the sierra

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## INTRODUCTION

Probably no group of plants is so greatly admired and so little kno as our ferns and their allies. Many people have been attracted to ferns their grace and beauty but have failed to continue their interest when a w of technical terms appeared to block their way. In this do-it-yourself age purpose of this book is to help the amateur as well as the trained botanis gain a better understanding of this group of plants in the Sierra Neva Although the main purpose of this book is the identification of these pla it is hoped that the additional material will show ferns are sometimes use and decorative.

Identification of ferns is not a difficult task. Ferns are much easier identify than the more numerous flowers and trees in our area. There only about 35 ferns in the Sierra Nevada and about 75 in the Pacific Sta according to Abrams (see references). The terms used for the identificatio ferns are somewhat different than the terms used for most flowering pla With a few new words one can master the identification of most ferns fou in an afternoon's outing. Of course, with the aid of illustrations the key almost be ignored. If an illustration appears identical to a fresh specim one is identifying, always confirm the species by reading the descript near the photograph.

There is disagreement among botanists regarding the scientific nam of many ferns. Although plant names are based on priorities, the final pri ties have in some cases not yet been decided. The name believed by author to have priority is the scientific name given here. Synonyms so times preferred by other botanists are indicated below the scientific nam It should be recognized that common names vary from one locality another, but the most commonly used name is the one given.

Do you have any native ferns in your garden? Many amateur garden are finding that the beauty of ferns can be taken into their gardens, so times to fill a cool, shady corner, sometimes in the crevices of a rock garc for ferns have a variety of habitats. The culture of ferns is not diffic Although some ferns do poorly in gardens, and the rock ferns in dried ho tats are not green and fresh during the dry summer months, many fe grow easily with a minimum of care. The Giant Chain Fern (*Woodward* the Sword Fern (*Polystichum*) and various species of Maiden Hair and F Finger Ferns (*Adiantum*) are among the favorites which are commo cultivated. Many native ferns are available in nurseries. They do best v yearly applications of leaf mold or peat moss, and, of course, most fe require frequent watering after the rainy season.

May we insert a word of caution to the reader? In our National Pa State Parks, and certain other areas **NO PLANTS ARE TO BE REMOVED** these areas would soon be devoid of their natural beauty. Soon noth would remain but a barren landscape. Can you imagine what Yose National Park would look like if each of the 1,500,000 visitors this year w to pick one fern or flower? It would be a major catastrophe! Specim should be collected elsewhere at least 100 yards from roads or trails obtained from your nursery.

An attempt has been made to include habitat and close-up photographs
s many species as possible. For background on all close-up photographs,
nch squares are used to show the scale.

A few species of ferns and their allies have not been collected or photo-
hed by the author and are not included. Most of the field work has been
ducted in Sequoia National Park, Yosemite National Park, the Sonora
area and adjacent foothills. Many of these ferns extend to the coastal
s of California, southward into Mexico, or northward into Washington.
eral information about distribution is given with each species.

The author wishes especially to thank Douglass Hubbard, Park Natural-
Yosemite National Park, and his staff for their assistance and for use of
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stant Park Naturalist, Sequoia National Park. Richard G. Prasil, Park
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Lassen Park. Paul F. McCrary of Yosemite National Park helped with
ng.

Ideas contained herein have come from Jepson's *Manual of the Flowering*
*s of California*, Abram's *Illustrated Flora of the Pacific States*, and Frye's
*of the Northwest*. Broun's *Index of North American Ferns* was the authority
nany of the synonyms and common names as well as total distribution
species. As early as 1939 the author spent time in the Sierra collecting
ts, including many ferns. In the spring of 1946 enroute to a ranger
ralist position in Yosemite for the summer, he was given a copy of
*semite Flora* by Mrs. Carlotta Hall, one of the authors. Enclosed in the
were notes written by her to bring the fern information up-to-date. That
has been carried on many trails in the park and much of the informa-
given by her is incorporated here.

The help of Rolla Tryon, Curator of Ferns at Gray Herbarium, Harvard
ersity, and his wife, Alice Tryon, is gratefully acknowledged. The
ns generously assisted in identifying ferns and reading the manuscript
rrectness of fern classification. Thanks are due also to Herbert L. Mason,
tor of the Herbarium, University of California at Berkeley, for his en-
gement and the loan of herbarium specimens. Much help in locating
mens to photograph in the field was received from material in the
mite National Park Herbarium, especially ferns collected by Mrs.
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ssistance of Michael McRae. Robert F. Hoover and Glenn Noble read
anuscript and made helpful suggestions.

The illustrations are original drawings or photographs by the author
s otherwise noted. Photographs were taken with a 4 by 5 inch Speed
nic Camera. All background grids in this book are ½ inch squares.

## THE STORY OF FERNS

Ferns differ from our cone bearing and flowering plants because fer produce spores, but no flowers or seeds or other large specialized reprodu tive structures. Both groups, ferns and seed plants, have many features common: Roots, stems, leaves, and a vascular system to conduct wat minerals and foods. Because flowers were absent the ferns and their alli were called Cryptogams (hidden reproduction) by early European botanis Until recently, ferns and their allies usually have been included in the lar category called Pteridophytes. Recently ferns have been included in t subphylum Pteropsida, along with seed plants.

In western America one thinks of ferns as common plants. The actu number of fern species is relatively few compared to the number in hum tropical regions where they occur in vast numbers and often in more speci ized forms. Such specializations include very thin, delicate filmy fer which must live in constant mist or spray, or noble tree ferns that atto great height. Only occasionally in temperate regions, but very commonly tropical rain forests, do ferns live on trees, and thus are called EPIPHYTE These epiphytes receive no nourishment from the living tree.

A mature fern plant consists of roots, a stem and FRONDS (leaves). T profusely branched root system serves to absorb mineral nutrients a water from the soil. The roots of some rock ferns, which live in very d habitats, penetrate to great depths and in mysterious ways grow towa moisture. Our ferns may have short stems above ground, but more oft have an elongated underground stem called a RHIZOME. The structu features of rhizomes, such as, size, degree of branching, length, and presen or absence of scales, are important in the identification of ferns. The gre FRONDS of ferns serve not only to manufacture food for the plant, but support the reproductive structures which produce dust-like asexual SPOR on the undersides of the leaves. The leaves may be quite simple but o often compounded in various ways (see illustrations p. 56).

Leaf and stem characters are used in identification of ferns, but m important is the arrangement of the spore-bearing structures on the undersi of the leaf. SPORES are produced in large numbers in special organs call SPORANGIA. SORI in the form of dots or lines are formed from clusters sporangia. Rarely a sorus may cover much of the undersurface of a fro Sori may form around leaf margins and in such cases the leaf usually cu around the sorus to protect the young sporangia. Any protective cover o a sorus, whether it be a curled leaf margin, a flap of tissue, or perhaps miniature umbrella, is called an INDUSIUM (See illustrations p. 55).

The story of a fern does not end here. What happens to the spores t are formed by the millions each year on a fern plant? It would be logica propose that they grew into new fern plants. When moisture is present o temperatures are suitable, that is what they do — only not into the fern pl with which people are most familiar. This new fern plant is part of an al nating cycle that represents the sexual phase of this plant and is a requi phase in the reproductive cycle. The spore develops into a small heart-sha green plant called a PROTHALLUS (See illustrations p. 51). RHIZOI

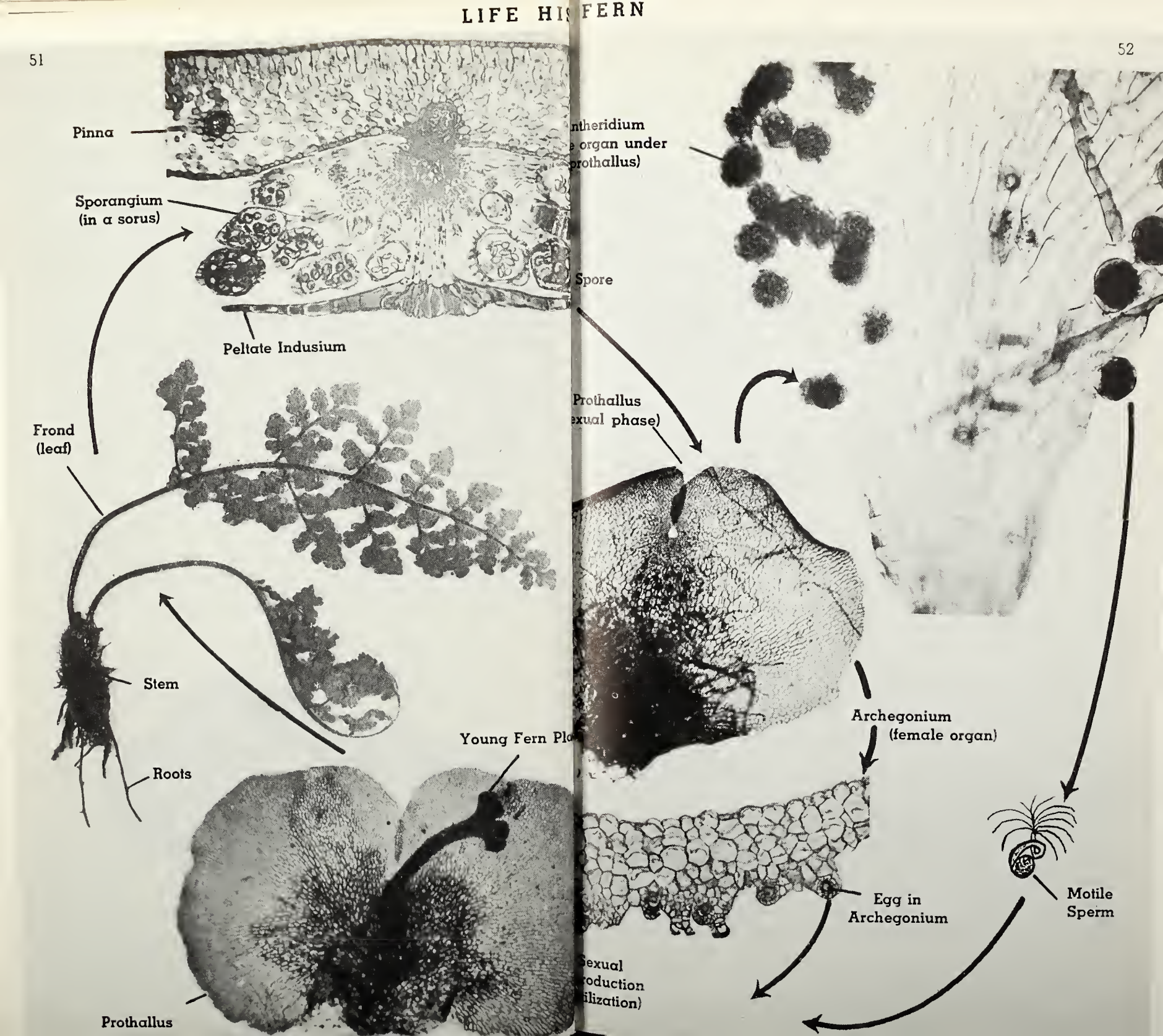
iature root-like structures on the lower side absorb water from the soil. ong the rhizoids, numerous spherical male organs are formed called THERIDIA which eventually produce myriads of motile SPERM that swim ne female organ. As many as 20 ARCHEGONIA, the female organs, may ur near the notch of the prothallus. Each archegonium contains one egg ch remains in the archegonium during fertilization and afterward. The lized egg develops into the familiar fern generation, absorbing some ient from the small prothallus until it is large enough to manufacture wn food. Only one fern plant develops from a prothallus, and as we see, the cycle of life and reproduction is completed. Thus a spore- ring generation, the familiar fern plant, always alternates with a small al generation. There can be no short cut except in a few species where tative buds produced on the leaves provide an asexual new plant, much arden plants are started by leaf or stem cuttings. The long underground s or rhizomes might also be considered a vegetative method of repro- ion because they promote the spreading of some species such as Brake s.

Ancient forests contained ferns as far back as the Coal Age. A few s are known in the fossil record even before that time although the ferns e not the most ancient vascular plants.

Ferns related to our Grape Fern, *Botrychium*, in the Adder's Tongue ily, Ophioglossaceae, are probably the earliest ferns in history which elated to our living forms. There are some related groups now completely ct of which the Seed Ferns or Pteridosperms are worthy of mention. e fern-like plants were more common in the Coal Age than true ferns. illustrations (pp. 50, 54) of fossil ferns are examples of the evidence ave of these ancient plants. More details of their preservation are ssed in the next chapter. Even though ferns were perhaps not a dom- part of the floras making up coal, they contributed to its formation.



Fossil fern from Mazon Creek, Illinois, with well preserved sori. This fern was living over 250 million years ago during the Coal Age (Carboniferous Period). Specimen courtesy of Ethel Doerer.


Pinna
Sporangium
(in a sorus)
Peltate Indusium
ntheridium
organ under
prothallus)
Spore
Prothallus
xual phase)
Frond
(leaf)
Stem
Roots
Young Fern Pl
Archegonium
(female organ)
Egg in
Archegonium
Motile
Sperm
exual
roduction
ilization)
Prothallus

## GLOSSARY

**Bi-pinnate** or **bi-pinnately compound** — twice pinnate with pinnules scattered along secondary branches (Illustration p. 56).

**Cilia** — hairs on margins of certain leaves, especially in *Selaginella.*

**Corm** — a condensed underground stem which stores food.

**Dichotomous** — a primitive type of branching which forks repeatedly into two equal branches.

**Elliptical** — from 3 to 4 times as long as wide, tapering equally from the center toward both ends.

**Frond** — leaves of certain plants such as ferns and palms (Illustration p. 5

**Imbricated** — overlapping of leaves, as shingles on a house.

**Indusium** — a protective covering over a sorus of a fern (Illustration p. 5

**Lanceolate** — lance-shaped, widest near the base, tapering toward the ape

**Linear** — a long narrow leaf.

**Marginal sori** — clusters of sporangia only at the margin of a pinnule.

**Oblong** — two or three times longer than broad, sides tapering somewh from the middle, or sides nearly parallel; nearly rectangular.

**Obovate** — egg-shaped with broadest part away from the attachment.

**Obtuse** — rounded or blunt.

**Orbicular** — round or nearly so.

**Oval** — broadly elliptical, about two times as long as the width.

**Ovate** — egg-shaped, broadest toward the attachment.

**Palmate** — branches or leaflets of a leaf all borne at the apex of a comm petiole, as all the fingers come from the palm of the hand.

**Peltate** — round, with a stalk attached on the underside at the midd shaped like an umbrella.

**Petiole** — stalk of a leaf or frond.

**Pinna** (plural: **Pinnae**) — a primary leaflet of a compound leaf.

**Pinnate** or **pinnately compound** — leaflets along both sides of a single peti or leaf stalk.

**Pinnatifid** — cleft in a pinnate manner, or deeply pinnately lobed.

**Pinnule** — the smallest leaflet of a bi-pinnately or more highly compound leaf.

**Rhizome** — elongated, horizontal underground stem.

**Segment** — smallest division of a frond; pinnules.

**Seta** (plural: **Setae)** — a soft bristle found at the apex of some leaves.

**Sorus** (plural: **Sori)** — a cluster of sporangia on the underside of a fe usually appearing as a dot or line, (illustration p. 55).

**Sporangium** (plural: **Sporangia)** — a reproductive organ producing asex spores.

**Spores** — an asexual reproductive structure consisting of a single cell.

**Submarginal sorus** — a sorus somewhat back from but parallel to the mar of a pinnule.

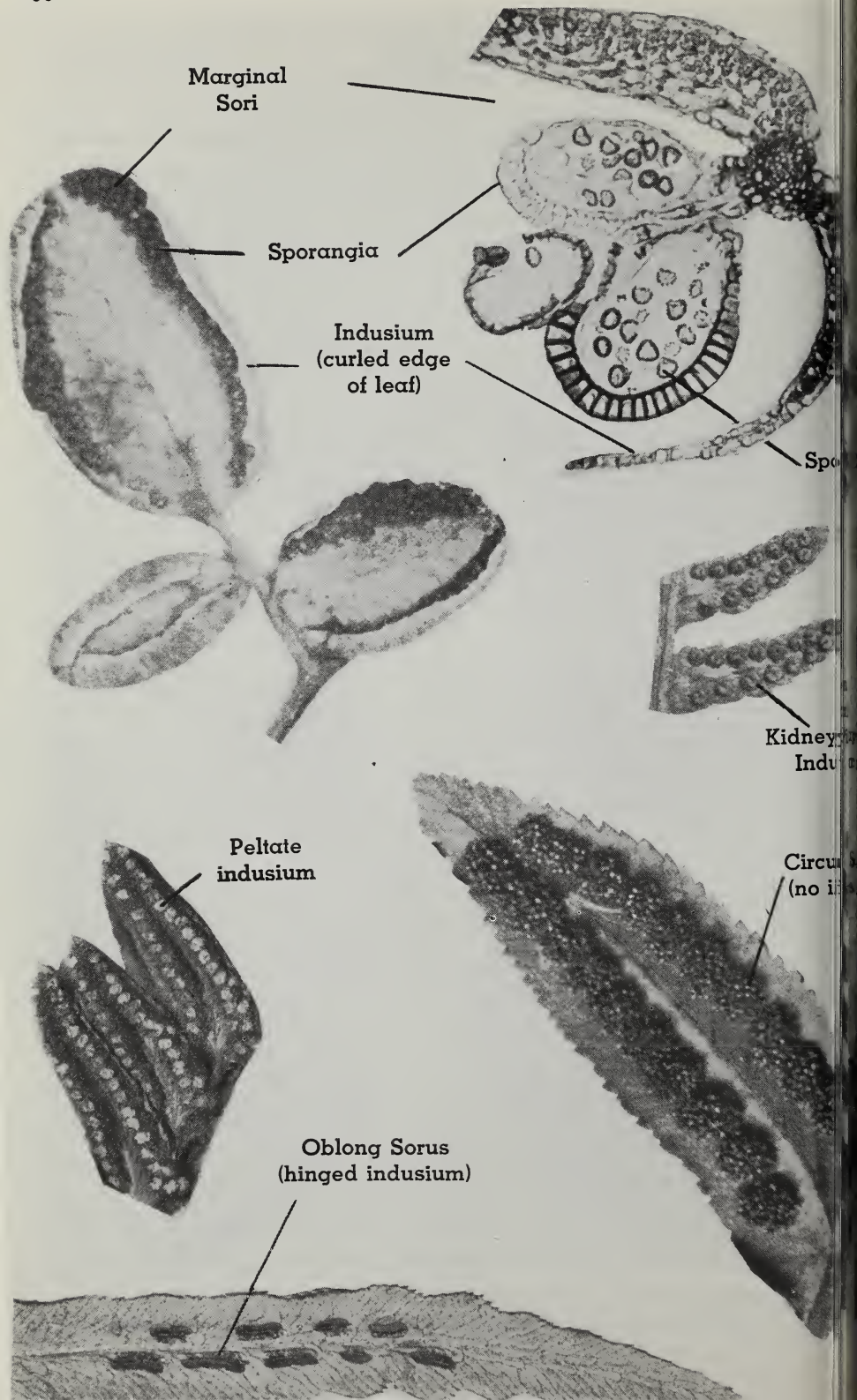
**Tri-pinnate** or **tri-pinnately compound** — a leaf branching three times w pinnules borne on the last branchlets.

Did you see a reversal of this curling effect? This optical illusion is mc
obvious when one realizes that these are not two halves of one nodule, b
two identical photographs facing opposite directions. Specimen courtesy
Frederick Essig.



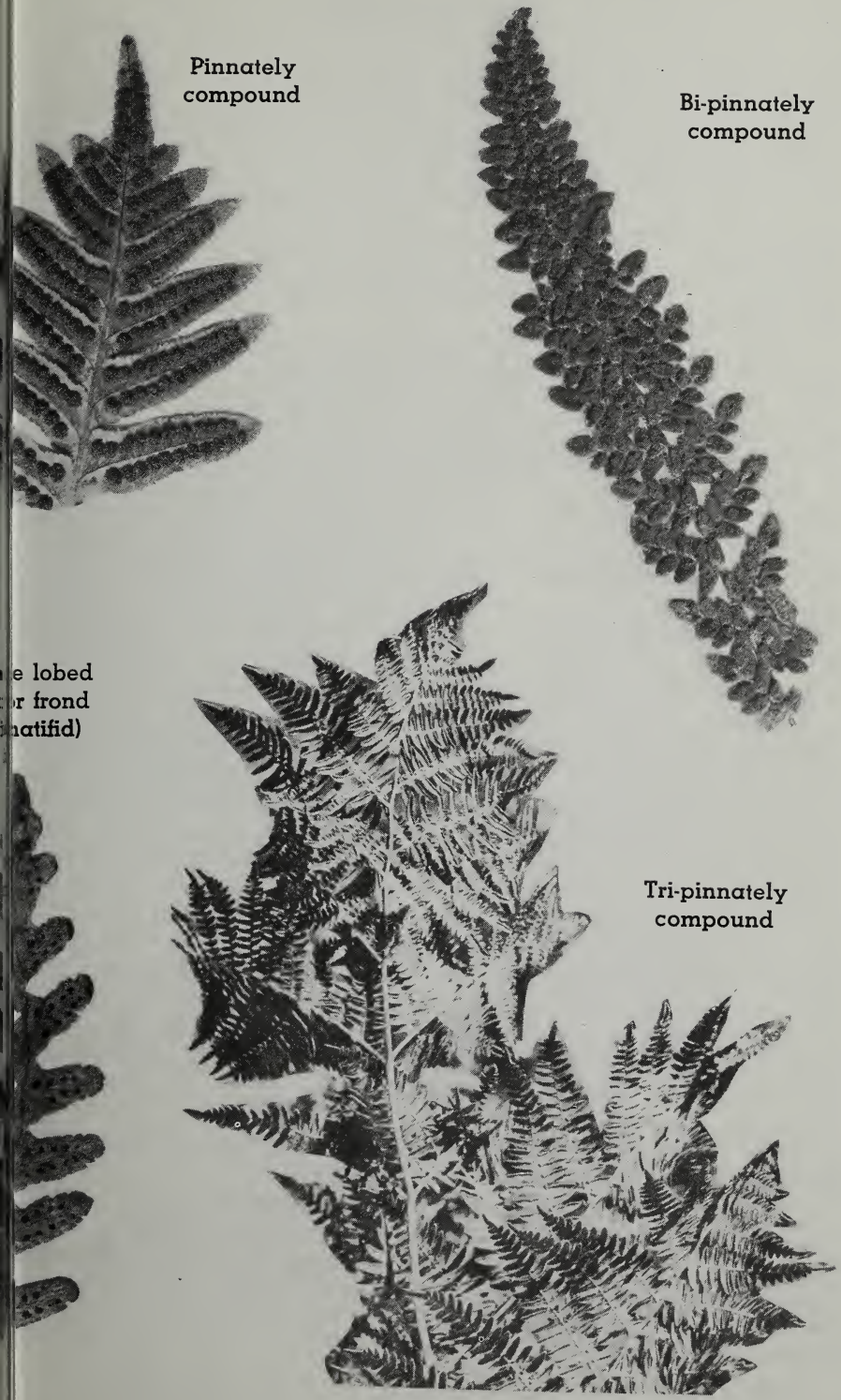
3 Fossil fern from Mazon Creek, Illinois, that lived during the Coal Age (Carboniferous Period). When a nodule is broken in half, the two halves show on imprint. Note that in one frond the pinnae curl down, in the other they curl up. Now turn this illustration upside down, looking continuously at one fern.

# FERN SORI


Marginal Sori
Sporangia
Indusium (curled edge of leaf)
Peltate indusium
Oblong Sorus (hinged indusium)

# FERN FRONDS




Pinnately compound
Bi-pinnately compound
e lobed
r frond
natifid)
Tri-pinnately compound

## THE FERN ALLIES

If we could suddenly transport ourselves back to the Coal Age, or C boniferous Period, as it is called by geologists, probably none of the pla in those magnificent rain forests would be familiar to us. Even the dinosa and other large reptiles feeding on them would seem strange, except to th who have visited museums to see the reconstructed plants and the anir skeletons. Yet these lush forests of trees 90 or 100 feet high and three feet diameter were the progenitors of our present spore-bearing vascular pla the ferns and their allies. These were the plants from which nearly all coal we burn had its origin.

In the ensuing ages as the climate of the northern hemisphere beca cooler and drier, many of these large spore bearing trees became extir and their extinction, in turn, may in part have been responsible for the exti tion of the giant reptiles who fed upon them. Through all the struggles existence, a few remnants of these plants survived and remain with us tod

All that we know about previously existing forests comes to us fr various fossil evidence such as carbonization, imprints, petrifications, casts. Coal represents carbonized plant material, but few structures are p served to identify the plants in the coal. Odd structures called coalballs, fou near coal formations, have furnished some of our best material for the stu of plants known during the Coal Age. It is not known how coalballs form Leaves which fell into slow moving streams or lakes were covered with c or sand and left permanent imprints showing the perfect outline and det such as vein patterns. These soil particles later became compacted to fo shale or sandstone in which the fossils may be discovered today. Some ste roots and cones have become petrified, meaning that most of all the orga material has been replaced gradually by dissolved mineral substances s as silicates or carbonates. Petrification is an extremely slow process t depends upon plants being kept free from fungi and bacteria which ca rotting. Plant structures which are to become petrified usually are cove by silt or volcanic ash and are thus protected from decay. Some trees wh were covered by mud or volcanic ash did rot out. In the cavity, dissol material seeped in. Thus a cast was made showing fine details of bark, l scars and other external features, but no internal structure was preserv

Unfortunately, a complete plant consisting of stems, leaves and co is never preserved in a single locality. Cones may be petrified in one a stems somewhere else. Leaf imprints are never found with petrified ste Stem casts are preserved under different circumstances.

Now let us examine briefly some of the major plant groups among fern allies, most of which are native to California.

The earliest fern ally appeared about 300 million years ago and sp mens of it are well preserved as petrified stems in chert of Rhynie, Scotl These earliest plants did not even have leaves, just forking stems wit simple vascular system and 4 spores borne at the top of the stem. A liv remnant of this oldest group, Psilopsida, is the genus *Psilotum*, not native California, but to the tropical areas of the world.

The Club Mosses or Lycopsida form a major group among the

llies with two of the four known genera growing in the Sierra Nevada. he living plants represent only a remnant of a large group once umbering hundreds of species. During the Coal Age many were large ees; our present species are mostly low growing erect or creeping plants. hese plants have roots, stems and small leaves, usually spirally arranged. he SPORANGIA, clustered at the stem tips in CONES, are not attached to ie stem, but to the top of the leaf, designated a SPOROPHYLL, or spore- earing leaf. Some cones are borne on special stalks, others are difficult to istinguish from a vegetative branch.

*Lycopodium*, one genus not represented in the Sierra, but found further orth, as well as in tropical areas, has HOMOSPORUS cones, in which all pores are the same size, similar to our common ferns. *Selaginella*, a genus in ur area, is HETEROSPORUS, having two kinds of spores in each cone: ICROSPORES, very small ones, and MEGASPORES, larger ones. The third mmon genus is *Isoetes*, which always grows in damp places and is often ubmerged in lakes or quiet streams. *Isoetes* in no way resembles the other enera. It looks much like a sedge or grass with long slender leaves which ave large air spaces inside. The stem of *Isoetes* is condensed into a storage sue called a CORM. The outer leaves actually are MEGASPOROPHYLLS, ch leaf bearing one sporangium with its numerous MEGASPORES at the se. The inner leaves are really MICROSPOROPHYLLS, each bearing one orangium with thousands of MICROSPORES.

The life cycle of Club Mosses is similar to ferns with alternating spore- aring and sexual generations. In those genera which are HETEROSPORUS e microspores form male plants, the MEGASPORES form female plants. ese sexual plants are small and sometimes not green, often parasitic.

The extinct Club Mosses, which were present as trees and shrubs in the rboniferous Period or Coal Age, became important components in Coal. ie example of an extinct genus is *Lepidodendron*, meaning scale tree, a large e with dichotomous branching stems and roots. Many casts and preser- tions of this tree show the leaf scars the whole length of the stem. Leaves the Club Mosses were either scales or long and narrow.

The last major group is the Horsetails or Sphenopsida with a single ing genus, *Equisetum*. Its 25 species are found in all parts of the world cept Australia and New Zealand. The jointed hollow stems have a reduced orl of leaves at every node, fused into a collar. Most of the photosynthesis curs in the green stems. In some species the stems are unbranched, in ers whorls of smaller jointed branches occur. The spores are borne in ies at the ends of the stems. Again in this group the alternating spore and ual generations occur.

Among extinct Horsetails the whorls of leaves were not always fused o a collar as in living forms. In *Annularia* (illustrated p. 61) the wedge- ped leaves are not fused to each other. Some of the extinct forms had a nbium which was the reason for much larger stems and roots than in our sent forms.

Our living fern allies represent a remnant which was able to survive the ere climatic changes on this continent and in other parts of the world, d have adapted themselves to their present environments.



Fig. 6 Carboniferous forest composed of now extinct species of Horsetails, Club Mosses, Ferns, and related plants as reconstructed from fossils. Courtesy of Chicago Natural History Museum.

## IDENTIFICATION OF THE FERNS AND THEIR ALLIES

### KEY TO THE GENERA

Aquatic spore-bearing plants — *Page*

A. Attached grass-like in pond or on moist soil ..... *Isoetes* 117

B. Floating, small, leafy, branching plants ..... *Azolla* 109

Terrestrial spore-bearing plants

A. Sporangia borne in cones

1. Creeping, leafy, moss-like plants, cones quadrangular in cross-section ..... *Selaginella* 114

2. Erect, jointed, rush-like, leafless except for collar-like sheath at nodes, cones round in cross-section .... *Equisetum* 109

B. Sporangia borne in clusters on a special stalk from basal part of plant ..... *Botrychium* 62

C. Sporangia borne on underside of leaf in clusters called sori

1. Indusium (cover over sporangia) absent

Underside of fronds white or yellow with a powder ..... *Pityrogramma* 94

Underside of fronds without any powder

Fronds deeply pinnately lobed or pinnately compound ..... *Polypodium* 96

Fronds bi- or tri-pinnately compound ..... *Athyrium americanum* 70

2. Indusium present, sori marginal or on underside of leaf

a. SORI MARGINAL, covered by curled leaf margin or marginal indusium

(1) Stalks light or straw-colored, except at base

Fronds of 2 kinds: Taller fertile and shorter sterile, plants less than 1 foot high ..... *Cryptogramma* 80

Fronds all alike, plants 1½ to 4 feet high ..... *Pteridium* 103

(2) Stalks dark-colored (except *Pellaea andromedaefolia* with tan to reddish stalks)

Delicate pinnae, midrib or pinnae not evident veins nearly all the same size and forking; grow in damp, protected places ..... *Adiantum* 66

Thicker pinnae, (except *Pellaea breweri*) midrib on pinnae or lobes always visible, sori more or less continuous, in dry exposed places.

Fronds and stalks scaly or woolly or both (except two species), indusia interrupted, or if continuous segments, bead-like .... *Cheilanthes* 73

Fronds not scaly or wooly, indusium continuous, bearing sporangia on surface of pinnae ..... *Pellaea* 86

Pag

b. SORI NOT MARGINAL, each covered with a special indusium

(1) Sori round or kidney shaped, plants rarely over 2 feet high

Indusium scale-like, attached to vein below sporangium, reflexed or somewhat deciduous in older fronds ..... *Cystopteris* 8

Indusium saucer or fringe-like, attached centrally to a stalk beneath the sporangia ..... *Woodsia* 10

Indusium shield-shaped, attached centrally above the sporangia

Indusia orbicular without a sinus .... *Polystichum* 10

Indusia kidney-shaped, or orbicular with a narrow sinus ..... *Dryopteris* 8

(2) Sori oblong or linear, tall ferns, usually over 2 feet high

Sori in rows, parallel to midrib on lobes of pinnae ..... *Woodwardia* 10

Sori in rows, oblique to midrib of pinnules or lobes of pinnae ..... *Athyrium* 7



Fig. 7 Split nodule revealing a preserved extinct horsetail, *Annular*
found in Mazon Creek flora of Illinois, from the Coal age (Carbon
erous Period). Specimen courtesy of Ethyl Doerer.

## OPHIOGLOSSASEAE

## ADDER'S TONGUE FAMILY

This family with two principal nera is based on *Ophioglossum*, genus not represented in the erra. Members of this family usually produce one leaf per year, and a special stalk bearing large spherical sporangia are located laterally.

## BOTRYCHIUM

### Grape Fern Genus

Perennial plants arising from a shy or fibrous rootstock, usually aring one leaf per year which dies wn during the winter. Leaves nple or compound, dichotomously ined, never net-veined. Spores rne on a special stalk, sometimes sing at the leaf base, at other es from the leaf stalk, the clus- ed sporangia appearing very ch like small bunches of green grapes.

This genus, although appearing quite specialized because sporangia form on a stalk and not on the lower surface of the leaf, as in most ferns, is considered our most primitive genus of ferns. Most species of this genus are from temperate parts of the world. Within any one of our species there is great variation of leaf forms.

### KEY TO THE SPECIES:

nts 2 to 5 inches high: leaves simple to compound ..... *B. simplex*
nts 12 to 18 inches high; leaves compound ..... *B. multifidum* var. *coulteri*

### LITTLE GRAPE FERN

**Botrychium simplex E. Hitchc.**
**(Fig. 8)**

lender plants 2 to 5 inches high; ves variable from simple, lobed, innate, or with divisions from the e with pinnate subdivisions. Leaf ments may be obovate, obtuse, nded or with blunt teeth or lobes. rangia borne on a stalk arising ase of the leaf, this stalk usually r than the leaves, a simple or pound spike; the lateral small green sporangia clustered near the apex. Spores are yellow.

This fern has also been known as the Simple Grape Fern. In the Sierra Nevada distributed from Tulare to Tuolumne counties at higher elevations. It is also known from Siskiyou County, north to Wyoming and British Columbia, east to Pennsylvania, New Jersey, and New Foundland, and in Europe and Asia. Although herbarium specimens show it to be widespread, this small fern

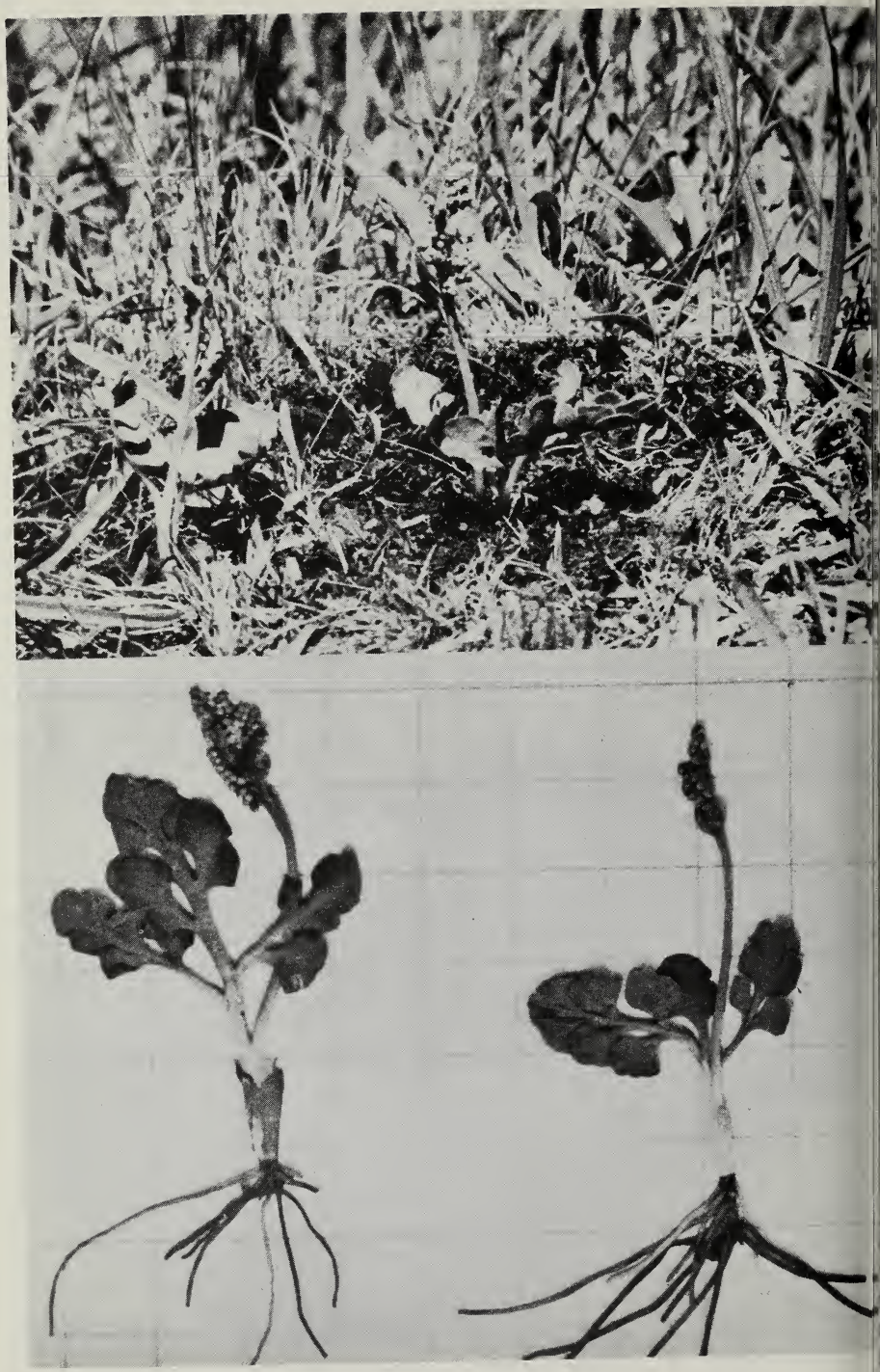


Fig. 8 LITTLE GRAPE FERN (*Botrychium simplex*). Upper: Habitat amo
sedges and grasses in an alpine meadow about 10,500 feet e
vation. Lower: Details of two whole plants.

often overlooked. As found in our gher open meadows, it is no taller an the short grasses and sedges round it. The author has searched many meadows in Yosemite for is particular fern. On one occasion Miguel meadows, when the author as accompanied by Dr. Herbert L. ason, who had collected this spe- es at that place 20 years before, ne could be found. *Botrychium simplex* is now apparently extinct in that area. A contributing factor may be the corral for government horses located there at present. Credit must be given to my faithful wife who found the specimens shown in the accompanying illustrations while we were on a pack trip to the Mono Pass area, near Kuna Creek, at about 10,500 feet elevation. It was quite plentiful in that meadow.

## LEATHERY GRAPE FERN

### trychium multifidum var. coulteri (Underw.) Broun (Fig. 9)

B. silaifolium as given by Jepson.

Plants 12 to 18 inches high, with ep rootstock. Commonly one lea- ry leaf with stalk mostly under- ound; leaf compound, ultimate seg- nts ovate or obliquely oval, unded or with blunt teeth. Two ves or dying leaf from previous ar sometimes present. Stalk bear- sporangia pinnately divided veral times with large green spor- angia clustered along the branches like grapes.

Usually found in open places in forests in humus or sandy soil, in mountains from 3,000 to 10,000 feet elevation. Known throughout western North America to Alaska, in Nova Scotia and in Europe. Because of the large size, this is the Grape Fern most frequently observed. It may be found in King's River Canyon; Lake Hamilton area in Sequoia National Park; above Mirror Lake, in Little Yosemite Valley and Tuolumne Meadows in Yosemite.

## POLYPODIACEAE

## FERN FAMILY

eaves called fronds have their gin from a rhizome which some- es is very short and condensed, may be much branched and te long. This family is distin- shed by the spores being borne the underside of the leaf. res are contained within organs called sporangia, usually clustered in groups called sori. These sori often occur as dots or darkened lines and may or may not be covered by an indusium or cover which is variously in the shape of an umbrella, a flap of tissue, or a rolled leaf margin.



Fig. 9 LEATHERY GRAPE FERN (*Botrychium multifidum* var. *coulteri*) From an open place in the forest in sandy soil, each plant having one compound leaf and a special stalk bearing clusters of sporangia. Plant is about 15 inches high.



r. 10 FIVE FINGER FERN (*Adiantum pedatum*). This fern lives on moist, rocky walls, receiving only a few hours of sunlight each day, or no direct sunlight.

## ADIANTUM

distinctive group containing our st graceful and delicate ferns. slender leaf stalk is black or wn, often shiny. The extensive derground stems, called rhizomes, y form mats. Sori marginal, the rangia attached to the reflexed es of the segments. Veins of the lets, easily visible, divided into equal divisions each time, never ing or forming a net-like pattern. hese ferns grow in moist places, ally protected from direct sun- t during part or most of the day, often where they have a north exposure.

*Adiantum* is used with flowers for corsages, especially when the leaf stalk has been singed in an open flame to prevent wilting. They are commonly cultivated in hanging boxes, and planted in shady corners of gardens. Most native species from higher altitudes die down during the winter. The dark leafstalks were used for black designs in baskets by several tribes of Indians in California (Kroeber).



Fig. 11 Upper: FIVE FINGER FERN (*Adiantum pedatum*). One frond with its finger-like branches. Pinnae are sterile. Lower right: Fertile pinna of the same species. Lower left: COMMON MAIDEN HAIR (*Adiantum capillus-veneris*). Some pinnae are sterile, others have moon-shaped marginal sori. Pinnate branches along the entire leaf stalk distinguish this fern from the Five Finger Fern.

KEY TO THE SPECIES:

eaf stalk forked only at the top, each fork bearing 3-8 pinnae on upper side ..... *A. pedatum*

eaf stalk with branches all along its sides

Pinnae not deeply cut between sori, margin of fertile pinnules rounded ..... *A. jordanii*

Pinnae more deeply incised between sori, margin of pinnules irregular ..... *A. capillus-veneris*

## FIVE FINGER FERN

### Adiantum pedatum L. (Fig. 10, 11)

A. pedatum var. aleuticum

Distinguished by leaf stalk one or ro feet high forked only near sum- it, each fork bearing a number of nnae. Pinnules arranged pinnately, l their sori being on the upper lge. Upper edge incised or notched etween sori, lower edge smooth.

Common in higher mountains of the Sierra Nevada from 3,000 to 10,000 feet elevation. It may be observed along several trails leading out of Yosemite Valley as on the horse trail to Nevada Falls, in Sequoia National Park along the middle fork of the Kaweah River. It is known from California to Alaska, in several eastern states, and in Canada from Newfoundland to Ontario.

## CALIFORNIA MAIDEN HAIR

### diantum jordanii C. Mull. ex Kuhn (Fig. 12)

A. emarginatum.

Erect fronds ½ to 2 feet high, dis- ctive because there are pinnate anches all along the leaf stalk. nnules nearly round or broadly n-shaped with sori located at ends veinlets. Very shallow incisions tween two successive sori.

Found in central Sierra foothills from 2,000 to 3,000 feet elevation. It can be observed near the highway west of El Portal, in the vicinity of Copperopolis, La Grange, and Jacksonville, Tuolumne County, in the months of February or March to June. It is common in coastal areas from the northern part of lower California to southern Oregon, and has been reported from western New Mexico.

## COMMON MAIDEN HAIR

### Adiantum capillus-veneris L. (Fig. 11)

Branching similar to *A. jordanii*, t this species has more drooping nds and pinnae are more wedge-shaped, sori shorter, distinctively moon-shaped, giving the fertile pinnules an irregular outline. Sterile pinnae deeply incised. Leaf form somewhat variable.

Grows on cool, shaded canyon walls at lower elevations, especially

on lime soils. Although this species is widespread in its total distribution, it is not common in the Sierra. Known in California from the coastal and inland areas as well as in many scattered locations in the United States and in temperate and subtropical regions around the world.

Fig. 12 CALIFORNIA MAIDEN HAIR (*Adiantum jordanii*). A fertile frond on the left side, a sterile one on the right. This fern closely resembles the Common Maiden Hair in its branching. Here the sori are not moon-shaped and notches between sori are never deeply cut.



## ATHYRIUM

Medium to large ferns, rhizome sually unbranched, sometimes fted. Fronds large, spreading, bi- tri-pinnate and erect. Sori on un- erside of pinnae in rows, oblong or moon-shaped, angled oblique to the midrib. Indusium shaped like sorus or absent. Located in moist places, often shady or protected places in forests, sometimes by streams or meadows.

KEY TO THE SPECIES:

eaf segments crowded on fronds, indusium oblong to moon-shaped, fringed with cilia ..... *A. filix-femina*

eaf segments narrow, oblique, indusium absent ..... *A. alpestre*

### LADY FERN

**Athyrium filix-femina (L.) Roth (Fig. 13)**

A. filix-femina var. californicum

Fronds 2 to 4 feet high, quite oad, often tapering toward the se, arising from a short rhizome. af forms variable from deeply in- sed with toothed lobes, to com- etely separate pinnules. Dorsal ri are oblong to moon-shaped, usu- ally toothed or with hair-like cilia on margins of the indusium.

Grows in shady or protected moist places, often in forests, from 4,000 to 8,000 feet elevation in the Sierra and is known from Idaho to Mexico, and in Europe and Asia.

This fern does well in gardens in cooler climates, especially if given sufficient moisture. It does not tolerate wind.

### ALPINE LADY FERN

**hyrium alpestre var. americanum Butters (Fig. 14)**

Athyrium americanum
Phegopteris alpestris var. americanum
Phegopteris alpestris

Plants ½ to 2½ feet high, usually her large, fronds nearly tripin- te. Sori round, very small, on ns below the apex of pinnae. In- sium absent. Fronds narrower n preceding species, although frequently resembling them in appearance.

This fern is found in moist meadows, in ravines and along creeks at higher elevations in the Sierra Nevada from 7,000 to 11,000 feet. It is distributed from California into northwestern Canada and Alaska and it is known from Colorado. It is also known from Lassen Volcanic National Park, and may be seen in Yosemite on Mt. Hoffman, in Iceberg Pass, and along Unicorn Creek.

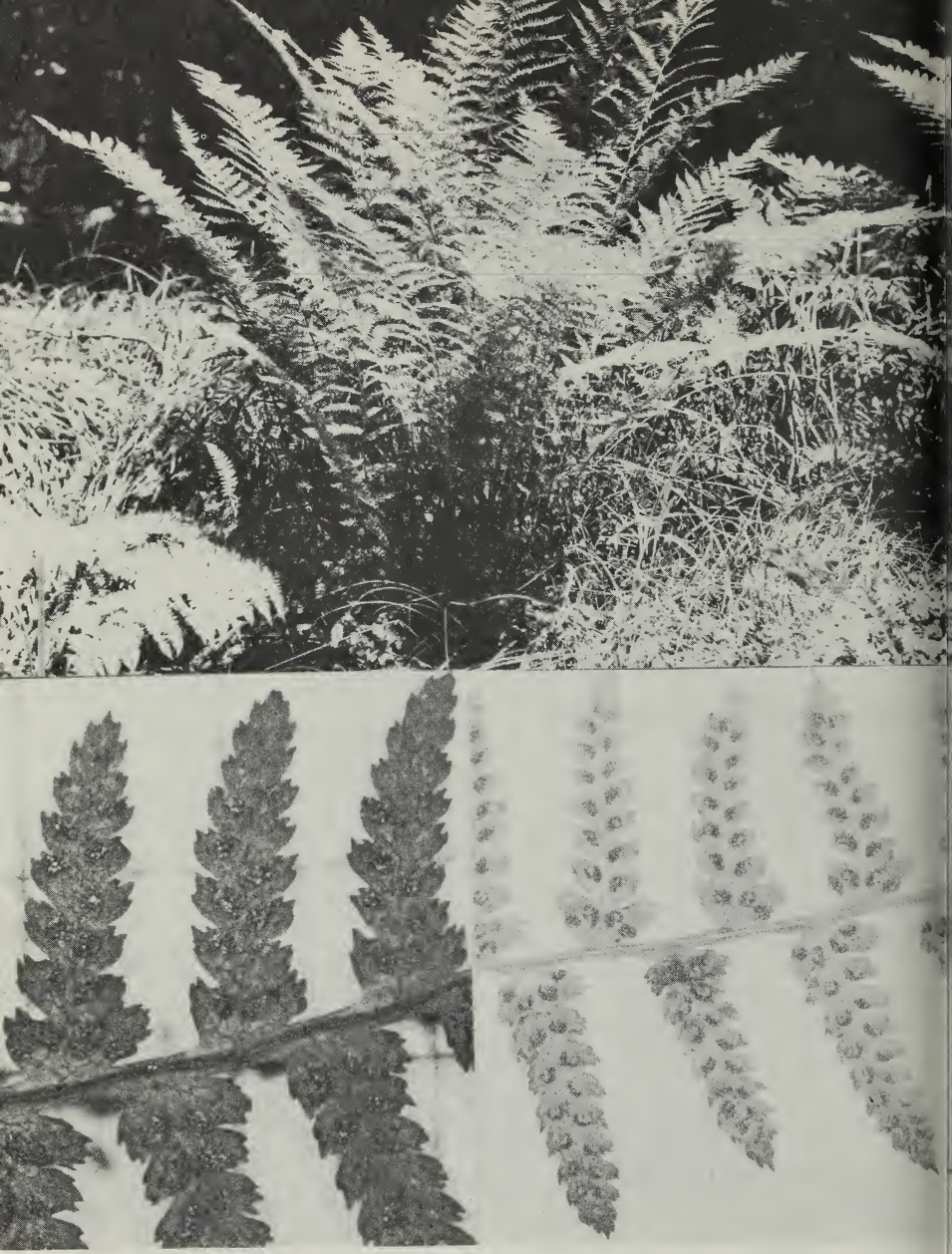


Fig. 13 LADY FERN (*Athyrium filix-femina*). Upper: Habitat in moist s
near a stream in a wooded area. Lower right: Young stage of s
when flap-like indusium covers sorus. Lower left: Older stage wh
enlarging sporangia in the sorus push back and cover indusiu
or cause it to fall off.



Fig. 14 ALPINE LADY FERN (*Athyrium alpestre* var. *americanum*). Left: A small frond. Right: One branch from a large frond. This species has no indusium.

# CHEILANTHES

Small ferns usually with some form of glandular hairs or scales on their leaves. Bi- or tri-pinnate leaves in which the fertile and sterile pinnae look very much alike. Pinnules may be lobed or incised, are often minute and bead-like. Sori may be distinct or continuous around the margins, more or less covered by an extension of the membranous leaf margin which serves as an indusium.

These ferns usually grow in cracks of rocks or on sandy, well drained hillsides, occasionally in seepage. Fronds curl up as the dry season continues and eventually die. The plants put forth new fronds when the rainy season comes, or following the melting of snows. Old fronds sometimes revive during rains.

## KEY TO THE SPECIES:

Pinnae without hairs or scales
- Sori distict, short, moon-shaped, in notches ..... *C. californic*
- Sori continuous on each side of a segment ..... *C. siliquos*

Pinnae with hairs or scales on the underside
- Sori not continuous around each segment; ultimate segments flat, glandular hairy on upper and lower surfaces ..... *C. coopera*
- Sori continuous around each segment, segments beadlike
  - Underside covered with woolly hairs, segments mostly oval ..... *C. gracillim*
  - Underside covered with membraneous lanceolate scales, segments round ..... *C. covill*

Fig. 15 CALIFORNIA LACE FERN (*Cheilanthes californica*). Left: Growin in cracks of rocks where moisture is available to roots. Right: So in notches of deeply lobed or incised leaf.







g. 16 INDIAN'S DREAM (*Cheilanthes siliquosa*). Upper: Dense clumps form when soil and water conditions are satisfactory. Lower: Details of one frond. Insert: Enlargement of segments to show details of sori.



Fig 17 Above: COOPER FERN (*Cheilanth*
*cooperae*). Upper: Two fronds and co
densed stem. Lower: Enlarged view
lobed hairy pinnae.

Fig. 18 Right: BEAD FERN (*Cheilanthes covillei*
Commonly grows in cracks of rocks i
dry places. Fronds curl in late sum
mer.

## CALIFORNIA LACE FERN

**Cheilanthes californica (Nutt.) Mett.**
**(Fig. 15)**

Plants 6 to 12 inches high, all of ıe short rhizomes covered with dark ɔales with pale borders. Pinnae ɔtched with sori occurring at ends veinlets in the notches. Indusium rmed by the leaf margin, roundish moon-shaped. Pinnae bright green and glabrous.

Found in rocky crevices near moisture, particularly common on talus slopes at the base of cliffs, often in shady places. Occasionally collected in the Sierra foothills south of Butte County between 2,000 and 4,000 feet elevation. It is known from the Arch Rock area and Cascade Creek in Yosemite, and in the hills below Sequoia National Park.

## INDIAN'S DREAM

**Cheilanthes siliquosa Maxon**
**(Fig. 16)**

Pellaea densa

Dense clusters of fronds 4 to 7 ches high arise from branched ızomes. The slender shiny stalks reddish-brown in color, fronds triangular in outline, tri-pinnate, at least at the base, bi-pinnate on the remainder of the frond. Segments of pinnae about ¼ inch long, varying from linear to nearly triangular in shape, normally coming to a point at both ends.



Found in exposed rocky places where the roots have access to moisture. Although not common in the Sierra, this species is widespread occurring from Sequoia National Park above Reflection Lake and Black Rock Pass northward into Oregon from 5,000 to 8,500 feet elevation. It has been observed in Yosemite beside many trails leading out of the valley as well as along the Crane Flat Road near the tunnels. It is also known in the Coast Range, and east to Montana, Wyoming, and eastern Canada, and from British Columbia.

## COOPER FERN

**Cheilanthes cooperae D. C. Eat. (Fig. 17)**

Dense clusters of fronds, 3 to 12 inches high, pinnae hairy and sometimes glandular, stalks dark brown, fronds oblong-lanceolate, bi-pinnate, each pinnule oblong, notched or incised, ⅛ to ¼ inch long.



Fig. 19
BEAD FE
(*Cheilanth*
*covillei*).
Lower si
two fron
show va
at one lo
Insert: T
view of
like segm

Not common, occurring occasionally in cracks of limestone cliffs and rocky places in the Sierra Nevada foothills below 2,500 feet elevation. This fern is known from Hites Cove, Mariposa County, and in a few scattered locations from Eldorado County south into Mexico.

## BEAD FERN

### Cheilanthes covillei Maxon (Fig. 18, 19)

Plants 2 to 8 inches high, 1½ inches wide at base or less, tri- or quadri-pinnate. Top of fronds green without hairs or scales, lower sides and stalk covered with chaffy scales: white on young fronds, brown on older ones. Sori marginal on bead-like segments, nearly obscured by the scales. This species closely resembles *C. gracillima* in general appearance.

This species is also known as Coville's Lip Fern. Found on rocky dry ridges, slopes and on peaks. Widely distributed in the Sierra from 2,500 to 6,500 feet elevation as well as in desert areas of southern California, in Arizona and Nevada,



Fig. 20
LACE FERN
(*Cheilanthes gracillima*)
Found in cracks of rocks in very dry places.

Utah and Lower California. It has been observed in Yosemite Valley at localities on the talus slope, on the south side of the valley near the western boundary of the park.

## LACE FERN

### Cheilanthes gracillima D. C. Eat. (Fig. 20, 21)

Clusters of fronds 2 to 8 inches high arise from a single much-branched rhizome, the latter covered with brown papery scales. Stalks without hairs or scales, reddish-brown in color. Bi-pinnate fronds glabrous above, woolly beneath with leaf margins rolled to cover marginal sori. Pinnules more or less oval to linear, frequently with slight lobing, particularly the basal ones of each branch, which may be unevenly lobed.

Distributed in the Sierra from Sequoia to Lassen Volcanic National Parks, ranging from 2,500 to 6,000 feet elevation and is also known from the North Coast Ranges to Idaho and British Columbia. It may be observed in Yosemite along trails leading from Yosemite Valley, including the trail to Merced Lake near Nevada Falls.

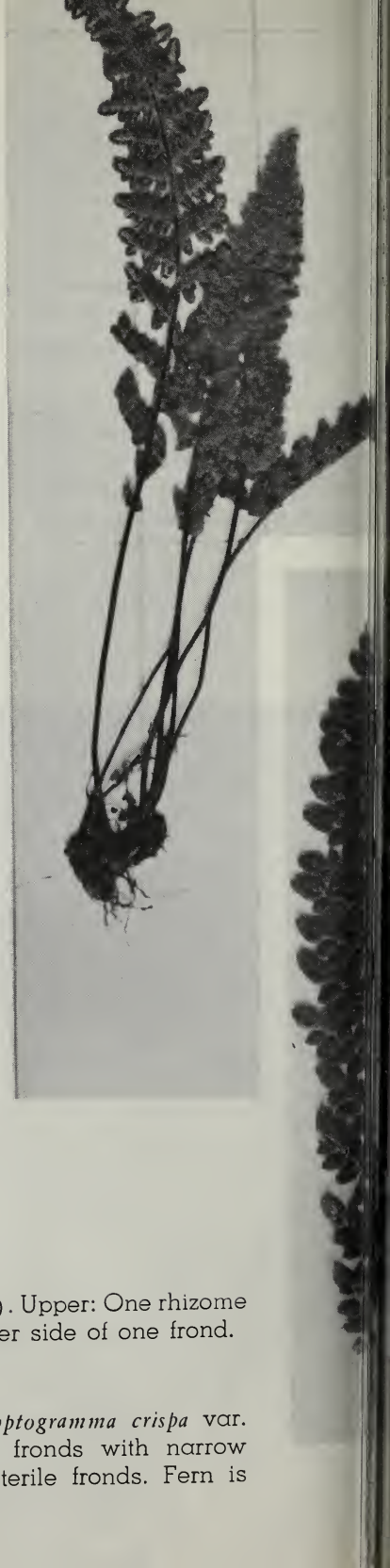


Fig. 21 LACE FERN (*Cheilanthes gracillima*). Upper: One rhizome with several fronds. Lower: Upper side of one frond.

Fig. 22 Far right: PARSLEY FERN (*Cryptogramma crispa* var. *acrostichoides*). The taller fertile fronds with narrow pinnae contast to the shorter sterile fronds. Fern is growing in decomposed granite.

## CRYPTOGRAMMA

Small ferns whose clustered bi- or -pinnate fronds have two distinct termixed forms: fertile fronds taller th linear to oblong pinnae.

Rolled margins form a continuous marginal indusium. Sterile fronds are shorter with ovate pinnae, notched or cut along the margins. Sori on backs of free veins, running together and covering under side of segment.

### PARSLEY FERN

**Cryptogramma crispa var. acrostichoides (R. Br.) Clarke (Fig. 22, 23)**

C. acrostichoides

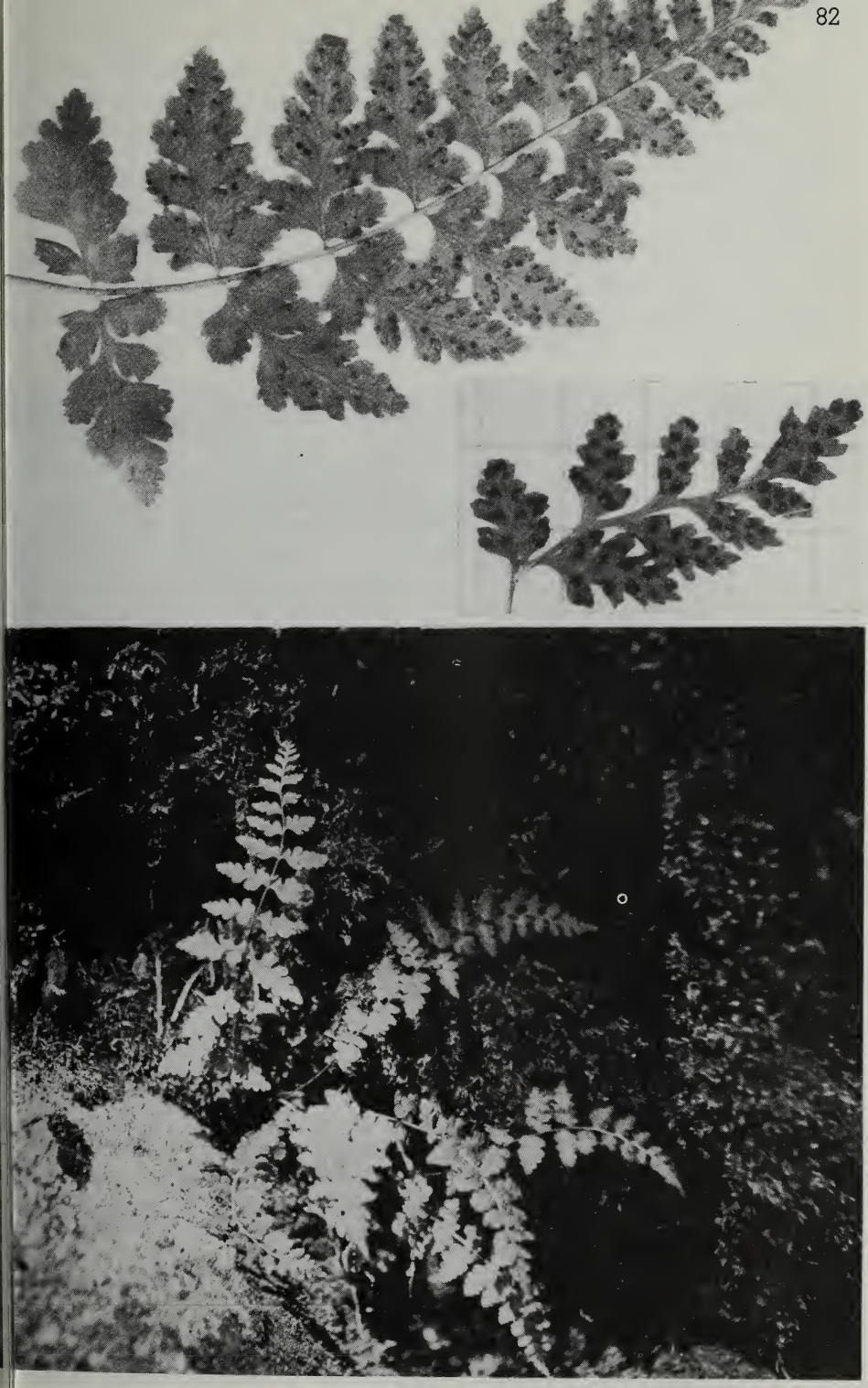
Plants 2 to 9 inches high, the fer- e fronds taller than the sterile ones. n sterile branches a narrow wing lows from the flat pinna down the lk, the wing usually absent in the tile stalk, or scarcely winged.

American Rock Brake is another common name for this species. Distributed from 5,000 to 10,000 feet elevation, more common in the higher elevations, in cracks of granite rock. Known from Alaska, Labrador, around the Great Lakes, and in Nebraska and New Mexico. It may be observed above Tenaya Lake, along trails leading out of Tuolumne Meadows and on Sentinel Dome in Yosemite.





Fig. 23 PARSLEY FERN (*Cryptogramma crispa* var. *acrostichoides*). Left: fertile frond, usually projecting several inches above the steri frond, as seen on the right.



. 24 FRAGILE FERN (*Cystopteris fragilis*). Upper: Frond with scattered sori. On some fronds basal pinnae also have sori. Insert: Close-up of one pinna from a larger frond. Lower: From a cool, moist, shady place. This one received moisture from the spray of a waterfall.

## CYSTOPTERIS

Small delicate fronds arising from a slender rhizome. Fronds bi- or tri-pinnate, slender, quite delicate. Small round sori on underside of the pinnae on free veins and covered with a membranous hood-like toothed indusium attached at the inner side of the pinna and partly folded under the very young sorus. The indusium is best observed in a young frond, soon being pushed back by the enlarging sorus, later withering and somewhat deciduous so that the old sorus may appear naked.

### FRAGILE FERN

**Cystopteris fragilis (L.) Bernh.**
**(Fig. 24)**

Polypodium fragile
Filix fragilis

Plants 4 to 16 inches high with bright green lanceolate fronds, variable in form. Some are pinnately to nearly bi-pinnately compound because of deeply cut lobes. In others, leaf tissue close to the branches of the stalk may connect most or all leaflets together on a single branchlet of a frond. Young sori black, scattered on under side of pinnae, always located over a veinlet. After spores are shed, sori appear brown

Sometimes called Brittle Fern, because fronds break off easily. The fronds of this fern resemble our Woodsias in size and general appearance, but the Woodsias are darker green and never have black sori. Sori of the latter are in rows near the leaf margin, not scattered. This fern grows in sheltered moist places, often along stream banks or in wooded areas. This is a widely distributed fern, occurring from Newfoundland and Labrador to Alaska, scattered locations throughout the United States, in Greenland, Iceland and Eurasia.

## DRYOPTERIS

Large, upright ferns arising from a creeping sometimes woody rhizome. Fronds pinnate or bi-pinnate, occurring as single stalks or more often in clusters. Sori round, covered by a distinctive kidney-shaped indusium which is attached to the pinna at the sinus of the indusium. A large genus in which most species are tropical.

### CALIFORNIA WOOD FERN

**Dryopteris arguta (Kaulf.) Watt.**
**Fig. 25, 26)**

Aspidium rigidum var. argutum

Several stout evergreen fronds 1 to 2½ feet high and 6 to 10 inches wide grow from each woody rhizome. Fronds bi-pinnate or nearly so, almost leathery in texture, without hairs on the upper side, but sometimes glandular beneath. Pinnae

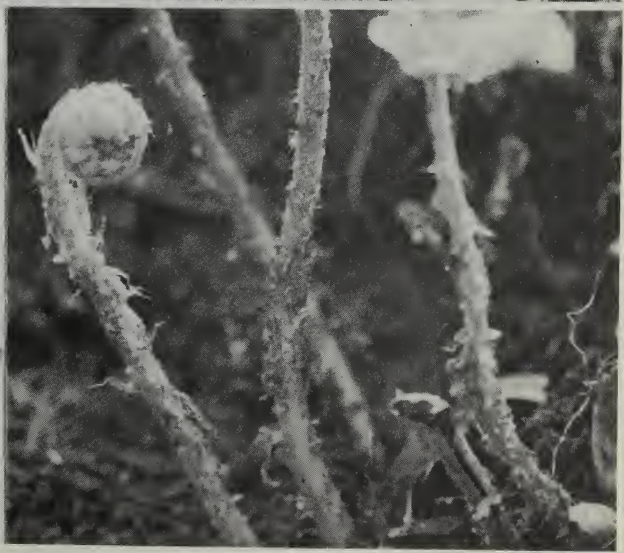
nceolate, deeply lobed or incised, ith kidney-shaped indusium which akes this species easy to recog- ize.

Sometimes this species has been called the Coastal Wood Fern. The California Wood Fern is commonly associated in the Sierra with the Sword Fern from 2,000 to 6,000 feet elevation, and they occur together

ig. 25 CALIFORNIA WOOD FERN (*Dryopteris arguta*). Upper: Growing in an open place in the woods. Lower left: View of the lower side of a portion of one pinna to show the kidney-shaped indusium. Lower right: New fronds coming out of the ground.







in semi-moist places throughout the state of California. They attain their greatest size in the foggy coastal mountains. The California Wood Fern may be seen on most trails leading out of Yosemite Valley, especially toward Nevada Falls and Yosemite Falls, and in Sequoia National Park at Bubbs Creek and Crystal Cave areas. It ranges from San Diego County to British Columbia and occurs in Arizona.

Fig. 26 CALIFORNIA WOOD FERN (*Dryopteris arguta*). Portion of one large frond with kidney-shaped indusia.



## PELLAEA

Small ferns arising from stout no-
ılar or slender much-branched
izomes. Erect pinnate to quadri-
nnate fronds usually without hairs
scales; smooth or shiny straw-
lored to dark brown leaf stalks
th scales at the base only. At the
ds of veinlets, sori form a marginal
rarely sub-marginal band. Leaf
rgin curled over sori to form an in-
sium or only slightly curled in
der fronds of *P. bridgesii.* Although
ere is some question if this species
ould remain in this genus, it will
placed here until further study
ien a more accurate placement
n be determined. This genus has about 70 species commonly found in temperate regions of the world. With 6 species and varieties in the Sierra it is one of the largest genera among our ferns.

All species in California occur in well drained, often dry situations. Mrs. Alice Tryon has noted that the British introduced a number of species in this genus to Kew as houseplants over 100 years ago, and that seven species were common in the nursery trade in the years that followed. A number of species grow well in cultivation with little special care other than rock substrata and good drainage. They can be maintained indoors as potted plants also.

### KEY TO THE SPECIES

gments with sharp tips
Pinnae semi-circular, segments longer than the midrib of the pinnae ..... *P. brachyptera*

Pinnae ovate-linear, segments shorter than the midrib of the pinnae
Fronds green, fewer than 20 segments per pinna .... *P. mucronata* var. *californica*

Fronds blue-gray or whitish, few to 40 segments per pinna, often with segments paired or in clusters of 3's ..... *P. mucronata* var. *mucronata*

ments blunt or notched at apex
Fronds pinnately compound
Segments entire, flat or folded in half ..... *P. bridgesii*

Segments deeply lobed, often mitten-shaped, margins rolled under ..... *P. breweri*

Fronds bi- or tri-pinnately compound ..... *P. andromedaefolia*



Fig. 27 COFFEE FERN (*Pellaea andromedaefolia*) Upper: Plant in dry fo
area. The curling of the leaves give the illusion of "coffee bern
Lower: Underside of a few segments showing marginal sori.

Fig. 28 Right: SIERRA CLIFF BRAKE (*Pellaea brachyptera*). One frond wi
very short lateral branches. Leaf margins curl around sori.



## COFFEE FERN

**Pellaea andromedaefolia (Kaulf.) Fee (Fig. 27)**

Plants 10 to 18 inches high, fronds bi- to quadri-pinnate, several arising from a slender rhizome. Young leaf stalks yellowish, straw or red-brown. Segments ¼ to ½ inch long, oval to somewhat rounded with blunt or notched apex. Foliage on upper side whitish or dull green in spring, turning bronze-purple in the drier summer weather, pale yellow or green beneath. In older fronds, especially in dry conditions, segments appear somewhat narrower because of curled margins.

The curled segments and bronze color give the illusion of coffee berries, hence the common name, Coffee Fern. The common name Sheep Fern has been used in a few localities because fragmented stalks puncture the intestines and cause death of sheep which occasionally eat this fern.

Common in the foothill areas of the Sierra in dry rocky places from 1,000 to 3,500 feet elevation, and in the coastal regions from Lower California into Oregon. It has been observed in Yosemite near Arch Rock and is abundant in the foothills below Sequoia National Park.

## SIERRA CLIFF BRAKE

**ellaea brachyptera (Moore) Baker (Fig. 28)**

Plants 6 to 10 inches high with veral slender fronds arising from ch rhizome. Woody rhizome is covered with brown scales. Bi-pinnate fronds have 3 to 6 pairs of pinnules crowded on short pinnate branches.

In rocky, exposed places, this fern grows between 3,500 and 8,000 feet elevation in the northern part of the Sierra including Lassen Volcanic National Park, into Oregon and in Trinity County.





Fig. 29 BREWER'S CLIFF BRAKE (*Pellaea breweri*) Upper: habitat of this delicate fern is at high elevations. Ferns are nearly prostrate when growing under rocks, erect in open places. Lower: Underside of two fertile fronds with lobed pinnae.

## BREWER'S CLIFF BRAKE

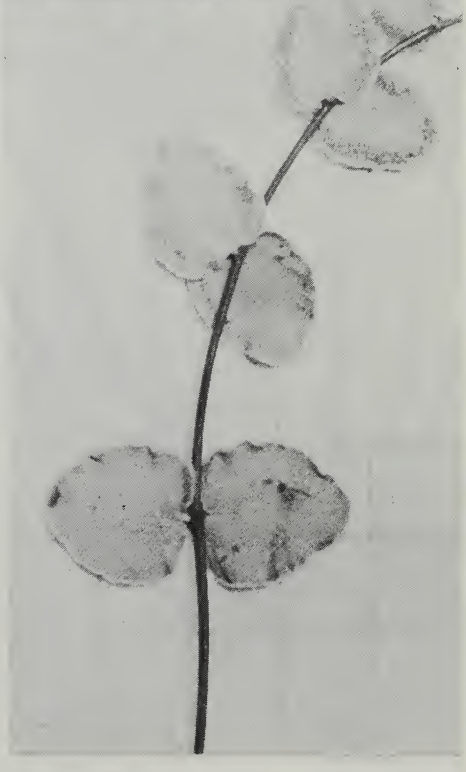
### Pellaea breweri D. C. Eat. (Fig. 29)

Plants 5 to 9 inches high with fronds in clumps. Short rhizomes covered with long brown scales. Stalks red-brown, quite brittle with dark brown scales near the base. Pinnately compound fronds with bi-lobed pinnae, or lower pinnae irregularly tri-lobed. This species closely resembles *P. bridgesii* which has no lobes on the pinnae. This species is much more fragile.

Among or under granite rocks between 7,000 and 11,000 feet elevation in the Sierra Nevada, lush fronds lie nearly prostrate under rocks, but plants in open are shor erect, but still fragile.

Sometimes this species has b called the Sierra Cliff Brake. T fern was first collected by Profes W. H. Brewer in 1864 near Son Pass between 7,000 and 8,000 elevation. It is known from the vi





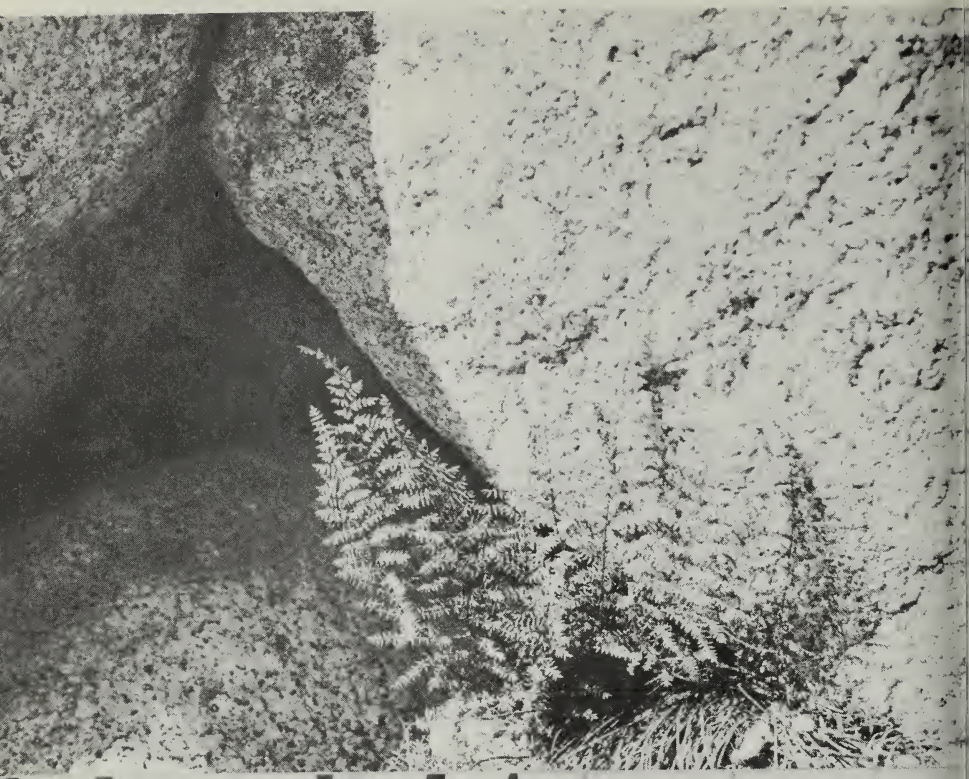
g. 30 BRIDGES' CLIFF BRAKE (*Pellaea bridgesii*). Upper: Growing in sandy soil and among granite rocks in dry places. Lower: Underside of frond showing scattered sub-marginal sporangia on all but lower pair of pinnae.

of East Lake, Kings Canyon Nanal Park, Pear Lake in Sequoia ıtional Park, from Mono Pass and several mountains near Mt. Dana Yosemite, and from Washington, yoming and Utah.

### BRIDGES' CLIFF BRAKE

**Pellaea bridgesii Hook.**
**(Fig. 30)**

Plants 4 to 8 inches high arising m a short rhizome which is coved with masses of brown scales. usters of pinnate fronds with lusus brown stalks arise from each zome. Pinnae round to ovate, light en in color with a leathery texe. Sori form a submarginal band





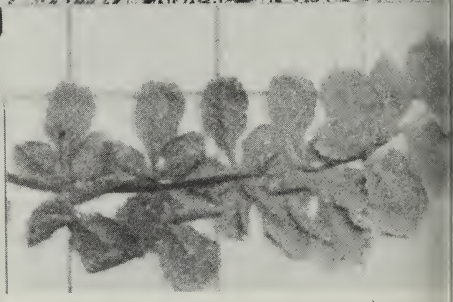


Fig. 31 BIRD'S FOOT FE
(*Pellaea mucronata* v
*mucronata*). Upper: Gro
ing in cracks of roc
Left: Detail of a sh
scaly rhizome and
bases of a few fron
Right: Portion of a ste
frond. These are ra
encountered, usually
pear after late spr
rains.

ch apparently at no time has a
curling of the leaf margin to
tect it. These latter characters and
litional features may eventually
a basis to place this species in
ther genus.
may be found in cracks of gran-
rocks in dry exposed places
0 to 11,000 feet elevation from
Tulare County, many localities in Yosemite, northward through the Sierra to Oregon and western Idaho. It may be seen near the animal trail a short way below Nevada Falls in Yosemite, along the main road in Forest of the Giants, Sequoia National Park, and along the Sonora Pass Road.

## BIRD'S FOOT FERN

**aea mucronata var. mucronata (D. C. Eat.) Tryon (Fig. 31, 32)**

P. ornithopus
P. mucronata

ants 8 to 18 inches high, arising
a woody nodular branched
ome. Young stalks of fronds
stnut to black, wiry and brittle.
sh-gray evergreen fronds usual-
tri-pinnate, at least in mature
ds, bi-pinnate in younger ones.
ae, at least at bottom of fronds,
in clusters of threes resembling
rd's foot. Pinnae linear or ellip-
with a sharp-pointed apex.
pson says this fern is sometimes
ed the Tea Fern, Black Fern, and Poison Fern. Like the Coffee Fern, *P. andromedaefolia*, the wiry stalks break into sharp pieces when eaten by sheep or goats, penetrate the intestines and cause death. According to Barrett and Gifford, the rhizomes which are sometimes 20 feet long were dug by Miwok Indians and used for brown coloring in their baskets. Also portions of this fern were steeped in hot water and the tea drunk to stop nosebleed or as a blood purifier.

This fern is common throughout the Coast Range and the Sierra in dry rocky places from 400 to 5,000 feet. It is found on the talus slopes in Yosemite near Arch Rock and extends southward into Lower California.

## DESERT CLIFF BRAKE

**aea mucronata var. californica (Lemmon) Munz & Johnston (Fig. 33)**

P. compacta
P. wrightiana var. compacta

nall fern, 4 to 8 inches high with
ral stalks arising from each rhi-
e. Young stalks dark brown to
k. From 3 to 7 ovate pinnules on
branch of a bipinnate frond.
ules curl when drying.

A fern distinctive from Bird's Foot Fern by having many fewer pinnules, never occurring in threes, and by having broader pinnules. This variety differs from the Sierra Cliff Brake by having longer lateral branches on which the pinnules are borne so that the segments are not so crowded.

Observed by the author only on the Avenue of the Giants in Sequoia National Park near Dorset Creek. Known only from a few localities in central and southern California.



Fig. 32 Above: BIRD'S FOOT FERN (*Pellaea mucronata* var. *mucronata*). Two fronds showing lower side with curled leaf margins. In specimen on right many segments occur in threes, and thus resemble a bird's foot, the origin of its common name.

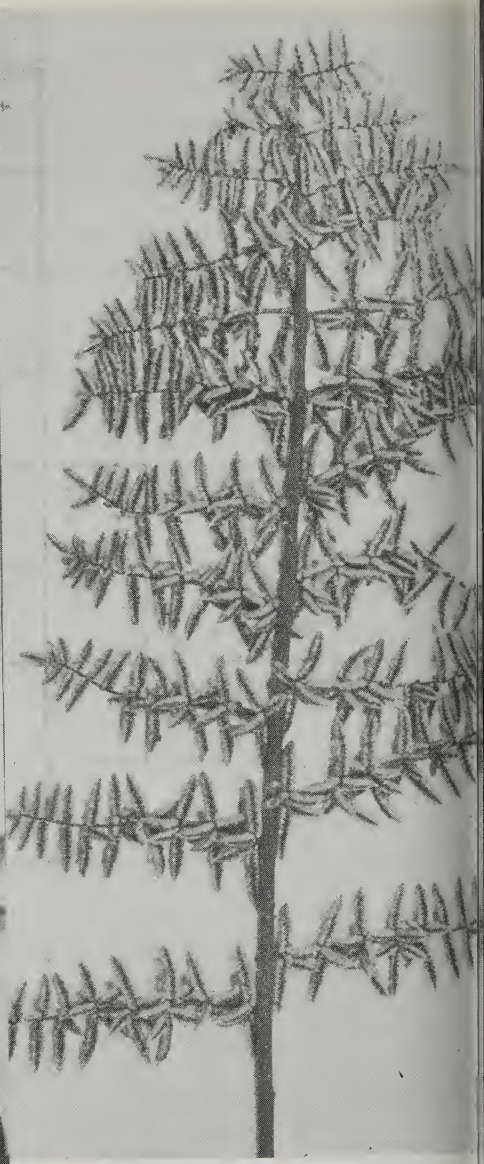


Fig. 33 Right: DESERT CLIFF BRAK (*Pellaea mucronata* var. *cal fornica*). Two fronds fro one plant showing variatio in number of pinnules ar in width of pinnules. Fron are somewhat immature.

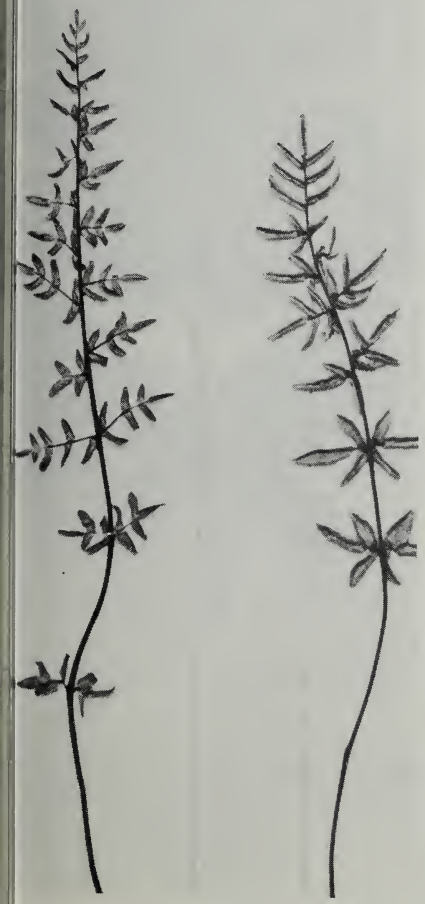
## PITYROGAMMA

mall ferns having clusters of ds with slender dark stalks. nds triangular or 5-sided in out- undersides covered with white ellow waxy powder. Sori appear k in mature fronds, in contrast ne light colored waxy particles. follow the very small veinlets, are so crowded that their forked or pinnate arrangement is obscured and the underside of each pinna appears to have one large confluent sorus. No indusium is present.

Although about 15 species of this genus are known in the world, mostly in tropical areas, only one species with several varieties, all found in California, occur in the United States.

### KEY TO THE SPECIES:

nds dark green above, golden yellow beneath when young *P. triangularis*
nds white above and beneath, and white on stalks .....var. *pallida*



### GOLD FERN

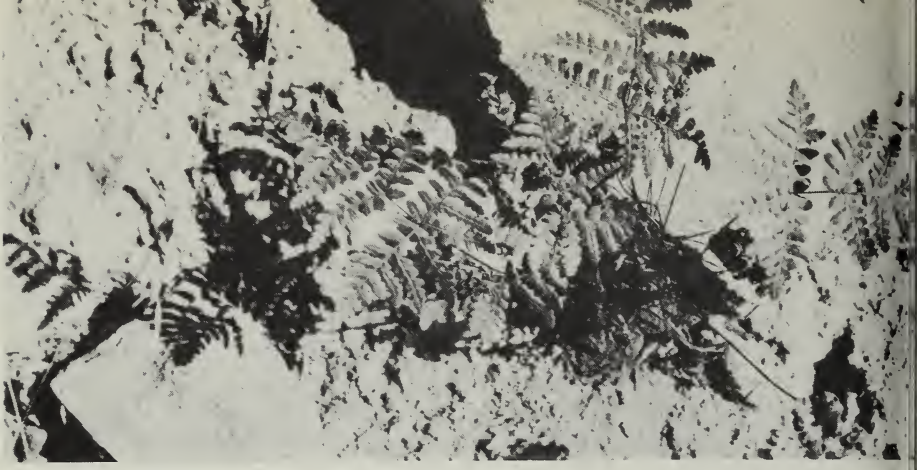
**Pityrogramma triangularis (Kaulf.) Maxon (Fig. 34)**

Gymnogramme triangularis

Fronds 3 to 12 inches high, easily recognized by its triangular shape, dark green color above and waxy golden yellow underneath on young fronds. As fronds mature most of the underside is covered with black sporangia, as shown in the illustration.

Gold Back Fern and Stamp Fern are other common names for this fern. An attractive golden print results when the underside of a young frond is pressed upon dark cloth or paper. This species, states Barrett and Gifford, was chewed for toothache by California Indians, care being taken to keep the quid near the troublesome tooth.

The Gold Fern is one of our more common ferns throughout the whole foothill area of the Sierra Nevada up to 4,500 feet elevation, and in the Coast Range. It occurs in damp places in sun or shade, in soil or cracks of rocky ledges. As the soil



dries out, the fronds curl and die. The plants remain dormant until the next rainy season when they produce new fronds. This species is found from Lower California to Alaska, and in Idaho and Arizona.

## WHITE FERN

### Pityrogramma triangularis (Kaulf.) Maxon var. pallida Weatherby (Fig. 35, 36)

A rare variety, closely resembling the preceding species, but distinguished by the whitish, waxy granules covering upper and lower leaf surfaces and also the stalk. As with the Gold Fern, the lower surface is gradually obscured by the dark sporangia which develop over the veins and cover much of the lower leaf surface. However, the underlying color of the top of the leaf in the White Fern is always a pale green, never dark green as in the preceding species.

This plant is occasionally found in the Sierra foothills below Sequoia and Kings Canyon National Parks, in Mariposa and Tuolumne Counties, and has been reported from Butte County. It is found in Yosemite near Arch Rock, but usually occurs at lower elevations.



Fig. 34 GOLD FERN (*Pityrogram triangularis*). Upper: Fo in soil where moisture available during the wi and spring months. Lo Details of lower side of frond when black sporan cover most of the gold w particles.



35 WHITE FERN (*Pityrogramma triangularis* var. *pallida*). Growing under granite boulders which form a cave. These ferns never grow in direct sunlight, although this variety may occur in more open places. White waxy material covers the stalks and both upper and lower surfaces of the fronds.

## POLYPODIUM

### Polypody

mall ferns with spreading rhi-
es and glabrous deeply lobed or
ate fronds. One row of sori is lo-
d on each side of the midrib of
innа or lobe and no indusium is
d in this genus. The rhizomes
lly are found in cracks of rocks or form mats covering rocks or imbedded in soil or moss.

Rhizomes of these ferns have long been enjoyed by the Indians of California both raw and roasted as a confection. Some species are reported to have medicinal value.

### KEY TO THE SPECIES:

ately compound fronds with sharp incisions between compact
innae, from sea level to 4,000 feet elevation .....*P. vulgare* var. *kaulfussii*
ately lobed simple frond with broad spacing between pinnae,
rom 5,000 to 8,000 feet elevation .....*P. vulgare* var. *columbianum*



Fig. 36 Left: WHITE FERN (*Pityrogramma triangularis* var. *pallida*). Lower s of one frond wit young sporangi partially obscur the white waxy material.

Fig. 37 F LICORIC (*Polypodi* var. *kaul* Habitat v close-up p details.

## LICORICE FERN

### Polypodium vulgare L. var. kaulfussii (D. C. Eat.) Fernald (Fig. 37)

P. californicum
P. vulgare var. intermedium

Slender fronds 2 to 18 inches high arise from rhizomes covered with papery brown scales. Membranous fronds which appear pinnately compound with considerable variation in shape and margins from long slender lobes to short, stout ones, margins toothed or not. Circular distinct sori ⅛ inch broad or sometimes larger. Sori yellow when very young, soon turning brown. The fronds gr erect, but sometimes droop.

Found on banks of canyons or cracks of rocks, often where th is some seepage, in Sierra Nevo foothills from Butte to Fresno Co ties, usually below 4,000 feet ele tion, and coastal California. This s cies grows near the base of Yosem and Cascade Falls in Yosem growing in cracks of rocks in sp from the falls. The fronds die do when the falls and their spray crease in volume, then plants main dormant until the follow spring. This variety is distribu from central California to Lower C fornia.



Fig. 38 GOLDEN POLYPODY (*Polypodium vulgare* var. *columbianum*). G
ing in seepage under a granite ledge so that direct sunlight n
reaches the plant.

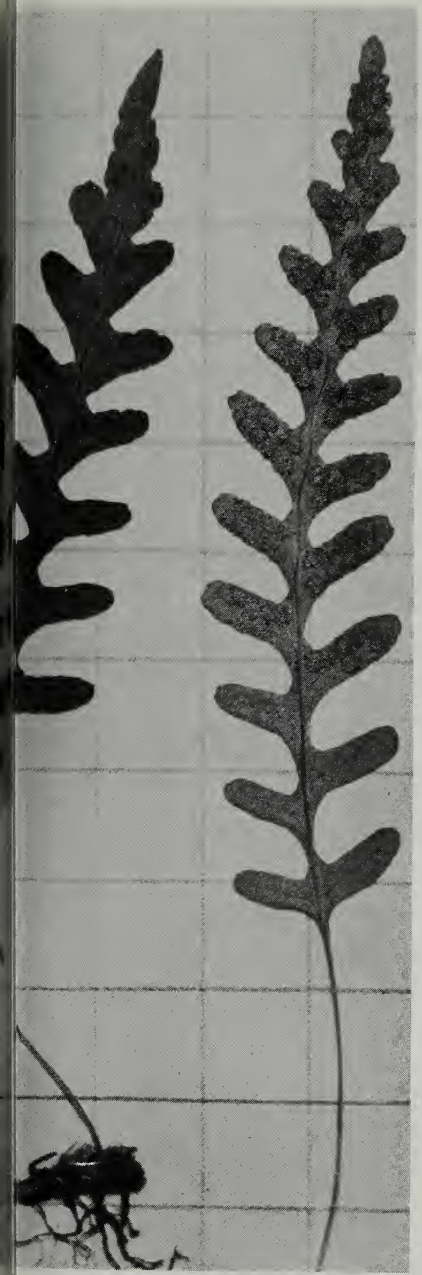
## GOLDEN POLYPODY

### Polypodium vulgare var. columbianum Gilbert (Fig. 38, 39)

P. hesperium
P. virginianum L. as given by Jepson is a mis-identification.

Plants 4 to 14 inches high from a rhizome similar to the preceding variety. Fronds pendent, somewhat leathery, pinnate lobes with considerable spacing, sori golden colored when young, from whence the plant receives its common name.

Known from the central Sierra region from 5,000 to 8,000 feet el
tion. It is not common and has
collected by this author only be
Strawberry Lake, Tuolumne Co
at 6,000 feet elevation. This va
was first observed there nine
years ago. The fern grows und
granite ledge, entirely shaded
direct sunlight and in constant
age. It has not spread to other p
in the intervening time. It is an
green when grown in cultivation
known distribution extends
British Columbia to southern
fornia and into South Dakota.



39 GOLDEN POLYPODY (*Polypodium vulgare* var. *columbianum*). Left: Portion of a rhizome and upper side of attached front. Right: Lower side of one frond with naked sori. Some fronds have sori on all lobes.

## POLYSTICHUM

### Sword Fern

Few to many fronds arise on the end of a stout rootstock. Evergreen fronds have a leathery texture, leaf bases are covered with papery brown scales. A large lobe occurs on upper side at base of each pinna. Sori are round with a peltate indusium, i.e., like an umbrella, but smooth around the margins.

### SWORD FERN

**Polystichum munitum (Kaulf.) Presl.**
**(Fig. 40, 41)**

Dark green shiny fronds 1 to 2 feet or occasionally as much as 3 feet long, lanceolate in outline, and pinnate. Round indusium slightly depressed in the center where stalk of the indusium is attached. Mature sporangia normally protrude beyond the edge of the indusium. Sori arranged in 2 rows down each pinna, the margins of pinnae being serrately toothed, the apex acute.

The Sword Fern and its variations are easily transplanted into gardens if kept in cool or at least partially shaded areas. It makes an excellent addition to bouquets because its shiny dark green fronds last well if kept in water and the pinnae do not drop off.

This species occurs in the Sierra Nevada up to 7,000 feet in elevation in open and wooded places where there is sufficient moisture. It is common in the Coast Range in the Redwood belt and is found as far north as Washington and Alaska, and in western Montana.



Fig. 40 SWORD FERN (*Polystichum munitum*). Upper: Many dark green shiny fronds arise from a short rhizome. Grows in open places or mountain sides. Lower L. to R: Pinnae of SWORD FERN, IMBRICATED SWORD FERN (form *imbricans*). and NUDE SWORD FERN (form *nudatum*), showing circular indusium common to all varieties



1 Right:
RD FERN
*tichum*
*um*). On
le frond,
ommonly
on all
e. Left:
SWORD
(form
*m*). Sori
only found
per half
ertile

## NUDE SWORD FERN

**stichum munitum Presl. form udatum (D. C. Eat.) Broun (Fig. 40, 41)**

P. munitum var. nudatum

ds 6 to 10 inches long, stalks scales only at base. Pinnae scattered, only slightly lobed on upper side at base. Sori confined to upper half of the frond.

Found occasionally in the Sierra Nevada from Mariposa to Nevada Counties. May be observed on the 4-mile Trail to Glacier Point, and along Ledge Trail.

## IBRICATED SWORD FERN

**stichum munitum Presl. form hbricans (D. C. Eat.) Clute (Fig. 40, 42)**

P. munitum var. imbricans

A small fern, usually not more than 15 inches high, stalk very chaffy at base. The distinctive features of this variety are the crowded pinnae which are imbricated or over-

lapping. Pinnae are obliquely inclined upward. Sori occur only on the upper half of the fronds.

Known in the Sierra from Plumas County and Yosemite where it may be observed on any trails up the southern walls of Yosemite Valley, it always appears in drier places and may be an ecological variation. It is distributed from California to British Columbia.

## PTERIDIUM

Brake Fern

### BRACKEN or BRAKE FERN

**Pteridium aquilinum var. pubescens Underw. (Fig. 43)**

Pteris aquilinum
Pteris aquilinum var. lanuginosum

A single frond 2 to 4 feet high arises annually from the end of each branch of long black rhizomes. Fronds triangular in outline, much compounded. Sori continuous around leaf margins with rolled leaf margin serving as an indusium.

The rhizome was used in textiles and baskets by California Indians for its black color (Kroeber). The tender fronds were also eaten both raw and cooked by Miwok Indians (Godfrey).

This coarse fern is acid-loving and may be found in shady wooded areas, where fronds are usually widely scattered, or may grow in open meadows where plants are more likely to develop into dense stands. It is widely distributed, being known from Quebec and the Great Lakes Region to Alaska, in South Dakota, Texas and California.

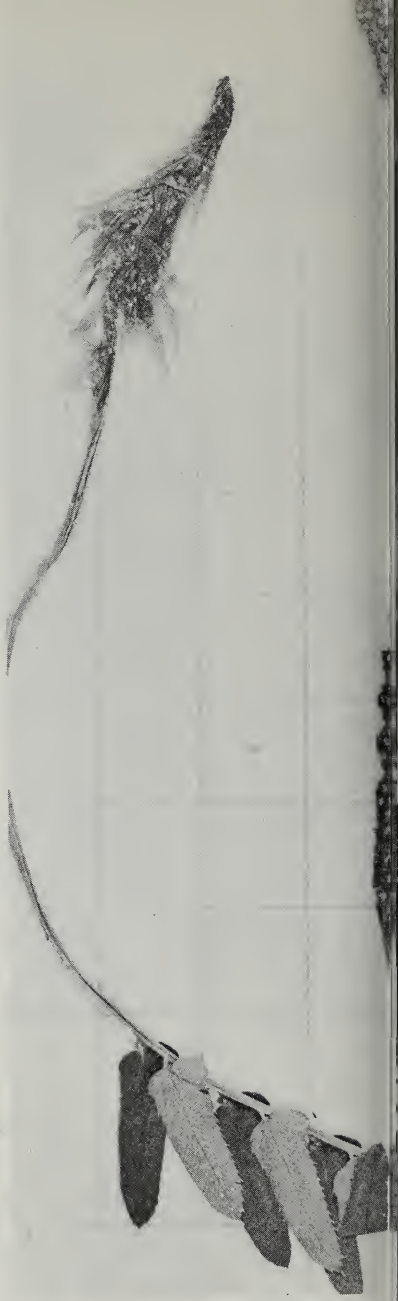


Fig. 42 IMBRICATED SWORD F
(*Polystichum munitum*
*imbricans*). One frond sh
ing the closely crow
pinnae which overlap,
the scales at the base o
frond.



43 BRAKE FERN (*Pteridium aquilinum* var. *pubescens*). Upper: One of our most common ferns in a wooded area. Also common in open meadows. Lower: Under side of one portion of a pinna with almost continuous marginal sori.

## WOODSIA

Small dark-green ferns, bearing sori the whole length of the fronds. Round sori in a submarginal position borne on backs of free veins with a delicate cup-like indusium attached under the sporangia. The indusi partly or entirely encloses the sp angia at first, often dividing ec into irregular lobes, forming a frin around the sporangia.

### KEY TO THE SPECIES:

Fronds with short hairs, glandular, divisions of the indusium narrow ..... *W. scopu*

Fronds without hairs or glands, indusium fringed with hairs ..... *W. oreg*

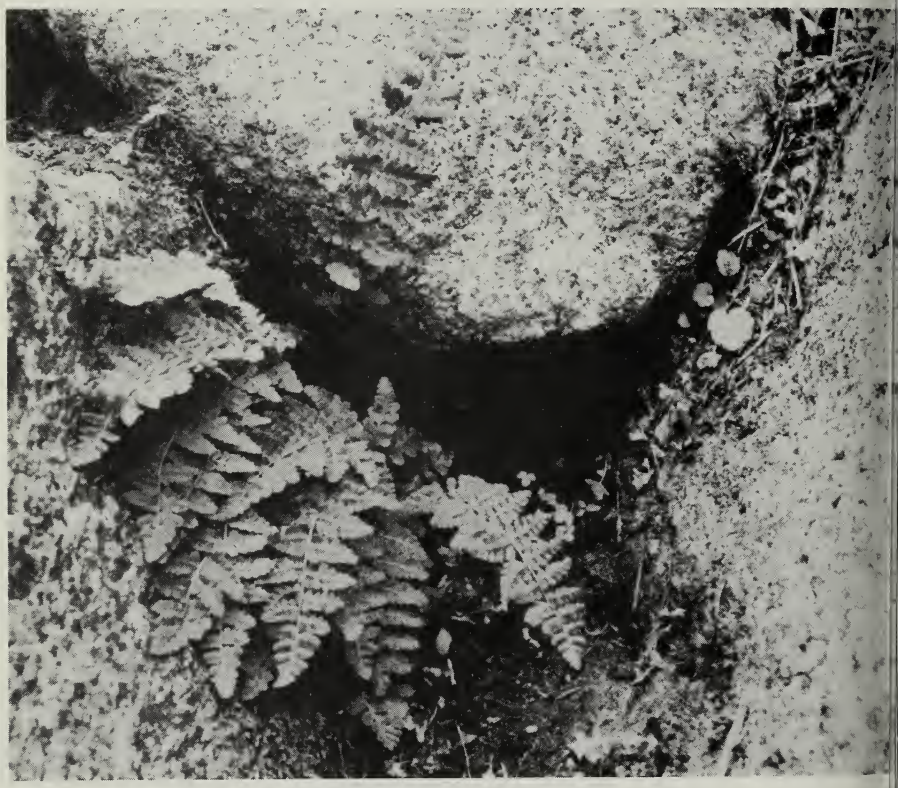


Fig. 44 Above: ROCKY MOUNTAIN WOODSIA (*Woodsia scopulina*). G in a cool canyon in moist soil.

Fig. 45 Right: ROCKY MOUNTAIN WOODSIA (*Woodsia scopulina*). U left: Lower side of a frond with its circular sub-marginal sori. U right: Top of one frond covered with short hairs. Lower left: Cu indusium attached beneath the sporangia of this species. L right: One fringed indusium beneath the sporangia from ORE WOODSIA (*Woodsia oregana*).



## ROCKY MOUNTAIN WOODSIA

**Woodsia scopulina D. C. Eat.**
**(Fig. 44, 45)**

Clusters of fronds 5 to 10 inches high with lower part of stalk dark brown, having a few scales. Dark green fronds broadly lancelate, covered with scattered multi-cellular or glandular hairs, usually bi-pinnate, or pinnate with segments deeply cut and toothed. Sori submarginal, indusium delicate, cup-like, divided into narrow divisions, ending in hairs (Fig. 45).

This fern closely resembles *Cystopteris fragilis* in size and general appearance. Both grow in moist places along streams. In *Woodsia* fronds are darker green, slightly curled down around the margins and sporangia are green when young, light brown when mature and after spores are shed. Young sporangia in *Cystopteris* are black; older sporangia appear brown after their spores are shed.

Although this fern is found in the Rocky Mountains, as its common name implies, and is widely distributed as far north as Alaska, south to Tennessee, Oklahoma and North Carolina, and around th Great Lakes, it is only known from a few places in the Sierra Nevada at elevations from 4,000 to 9,000 feet including Ouzel Basin and Hamilton Lake area in Sequoia National Park and from Mono Pass and the Ledge Trail in Yosemite. It has been found as far north in the Sierra as the Modoc Lava Beds.

## OREGON WOODSIA

**Woodsia oregana D. C. Eat.**
**(Fig. 45, 46)**

Very similar to Rocky Mountain Woodsia in general size and shape



Fig. 46 OREGON WOODSIA (*Woodsia oregana*). One frond showing the sori in submarginal positions.

of fronds and location of sori. Here fronds are glabrous, free from any glands or pubescence. The indusium seated under the sporangium has hair-like lobes, which in young sporangia reflex upward, and appear to enclose the sporangia (Fig. 45).

Found from 4,000 to 5,000 feet elevation at a few places from San Bernardino County northward into Washington. Not common in the Sierra. This species closely resembles *Cystopteris* as noted in the above species. It is found from Lower California to British Columbia, in Quebec, Oklahoma, and New Mexico.

## WOODWARDIA

## GIANT CHAIN FERN

### Woodwardia fimbriata Sm. (Fig. 47 and cover)

W. chamissoi
W. radicans as given by Jepson is a mis-identification

Fronds from 3 to 6 or even 8 high, pinnae 4 to 18 inches l broadly lanceolate in outline pinnately cut almost to the mi segments minutely toothed, s what scalloped. Sori oblong-line cavities, in a chain on each sid the midvein of the segments. In ium fixed by its outer margin hinged to open and allow spor be disseminated.

Indians in the Sierra are repo by Kroeber to have used the fi from this fern dyed red with a bark for basket and textile desi

The largest and most magnifi of our ferns, the Giant Chain F is widely distributed throughout fornia in the Coast Range and ra, although never considered mon. It always occurs where is constant seepage, such as Fern Creek, and several pl along the Kaweah River in Seq National Park; along the Me River a few miles below El P near Cascade Falls, and across footpath at Happy Isles, Yose Known from British Columbi California.

Hall reported a dwarf form several points in Yosemite Va The author transplanted this into the San Joaquin Valley 12 y ago and it now has fronds 3 long, which is considerably l than the dwarf in Yosemite, b has not grown to the size of the l form from the Sierra.

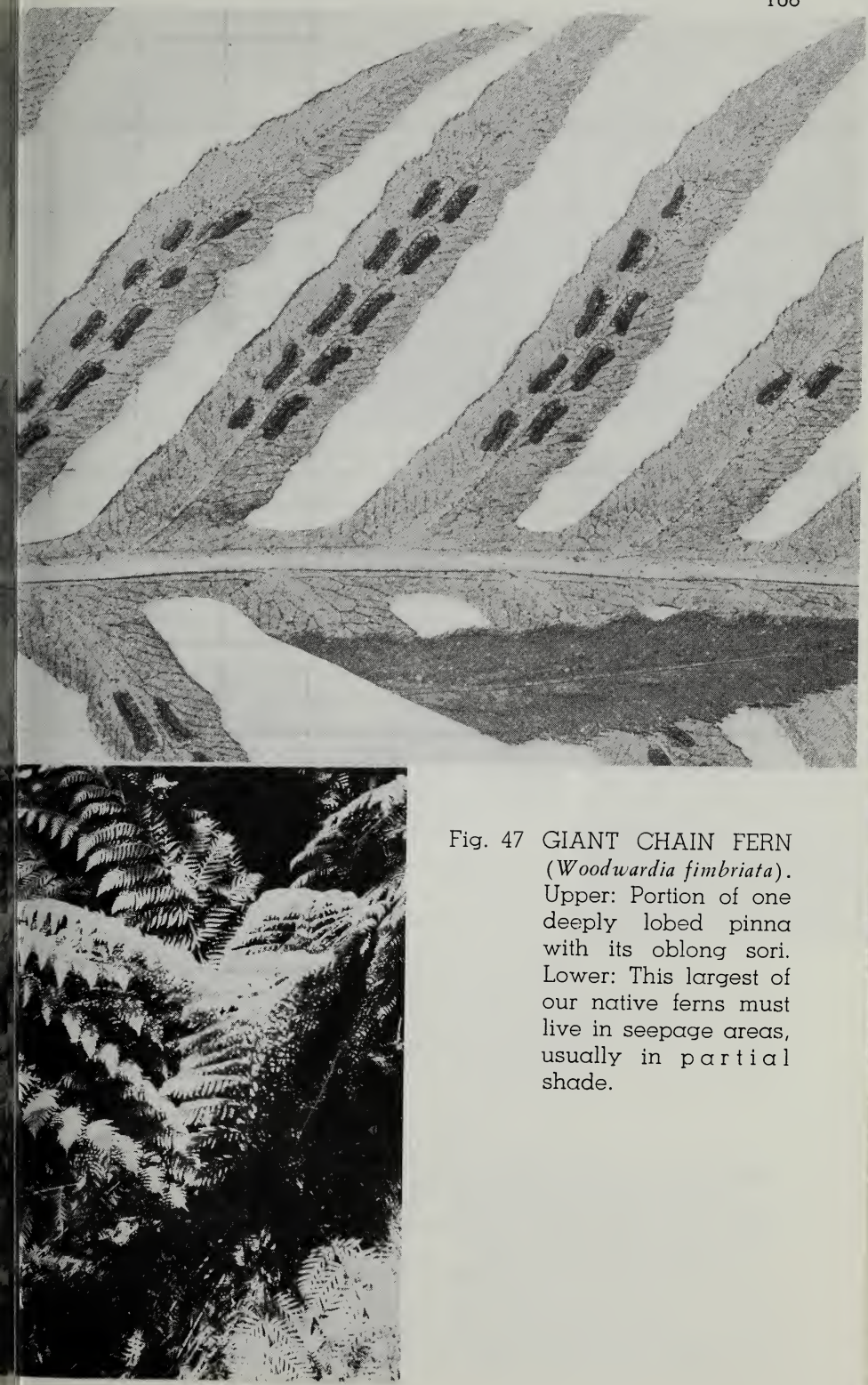


Fig. 47 GIANT CHAIN FERN (*Woodwardia fimbriata*). Upper: Portion of one deeply lobed pinna with its oblong sori. Lower: This largest of our native ferns must live in seepage areas, usually in partial shade.

## SALVINIACEAE
## SALVINIA FAMILY

### DUCKWEED FERN

**Azolla filiculoides Lam. (Fig. 48)**

Small floating aquatic plants ¼ to 1 inch long which branch pinnately and bear crowded overlapping 2-lobed leaves on the upper side of the stems, a few roots on the lower side. Spores are contained within a special structure called a SPOROCARP, submerged in water on lower side of the stem. Two or more sporocarps may occur on one branch, each containing 1 megaspore or microspores.

Sometimes called the Fern Azolla, these moss-like plants green or dark red, often occur in masses that cover ponds or p of quiet water. Widely scatt among the western states, in l elevations in California in the ras at such places as Three Ri La Grange, Mormon Bar near posa, north to Modoc. The spe also occurs in Mexico and S America.

## EQUISETACEAE
## HORSETAIL FAMILY

### EQUISETUM

Erect plants arising from a black perennial branching rhizome. Stems hollow except at nodes, with sheaths at nodes. Sheaths represent whorls of fused leaves. Fertile stems terminate in a cone which bears sporangia. It is advisable to identify these plants from fresh material since artifacts are sometimes produced which would provide misleading results in keying. For example, the collar or sheath which is tight around the stem in fresh material of some species may not shrink as much as the stem in drying, and thus appears flared, a characteristic of a different species.

Indians of central California *Equisetum* to polish their arrows cording to Kroeber. The abr quality of the stems due to sili in the cell walls was well know early white settlers in the west used them to clean household sils, hence the name "scouring applied to some species by the neers. This abrasive is also s cause death in sheep and catt a result of internal hemorrha number of species of *Equisetum* been used medicinally as h They contain aconitic acid an used as diuretics.

KEY TO THE SPECIES:

Two kinds of stalks: sterile with whorls of branches, and unbranched fertile ones with terminal cone ..... *E. a*
Only one kind of stalk, eventually bearing cones
  Cones pointed at apex
    Sheath at nodes closely pressed to stem, stems rough to touch ..... *E. hi*
    Sheath flared at nodes, stems smooth to touch ..... *E. laevi*
  Cones rounded at apex ..... *E. kan*



8 DUCKWEED FERN (*Azolla filiculoides*). Upper: This small fern can be found floating in sluggish streams of foothills. Lower left: Top view (left) of one branched plant and bottom view (right) showing two sporangia and microspores. Lower right: Close view of a mass of this fern in its normal habitat.

## COMMON HORSETAIL

**setum arvense L. (Fig. 49, 50)**

ile stems ½ to 2 feet high, r, 10-15 furrows, nodal sheath ending in about 12 brown Whorls of branches numerous, as in the stems with only 4 teeth on each sheath. Fertile stems 4 to 7 inches high having 3 to 5 nodes with long, loose sheaths, often brown, and a terminal spore-producing cone 1 to 1½ inches long. Fertile stems appear very early in the spring and are rarely seen because after a few days they shed their



Fig. 49 COMMON HORSETAIL (*Equisetum arvense*). Upper: Grow
sandy stream bank. Sterile branches only. Lower: C
SCOURING RUSH (*Equisetum hiemale*). Growing as a den
in both open sunlight and in shade.

res and die down. The sterile ks remain for the whole season. ommon in sandy wet soil in or r streams or swamps 2,000 to 0 feet elevation in the Sierra Ne- a. Also known from the arctic, ope, Asia, and northern Africa.

## COMMON SCOURING RUSH

**Equisetum hiemale L. var. alifornicum Milde. (Fig. 49, 51)**

out evergreen stems 2 to 4 feet , rough to touch, simple or rare- ranched, branches usually bear- cones. Whorls of sterile branches present at the nodes. Long brown on the sheath at the nodes are duous early in the season, leav- a smooth rim to the sheath. The th nearly or quite as broad as , close to the stem, never flared it. Color characteristics of the ths variable in the species, but cally gray in color. In younger s one upper black ring present; der stems an upper and a lower k ring usually visible. The ovate s are ½ to 1½ inches long, yel- or black, pointed at apex.

so known as the Western Scour- Rush and the Rough Scouring . The rhizomes may extend a t distance underground. One me, which the author traced, nded 6 feet from the nearest cal stem on the same plant. This ies grows in the Coast Range Sierra Nevada from 2,000 to ) feet elevation along sandy m banks sometimes in very e stands. Known in Alaska, and California.

## SMOOTH SCOURING RUSH

**Equisetum laevigatum A. Br. (Fig. 51)**

milar in general appearance to *male*, but the stems here usually smaller, always smooth to touch. Evergreen stems 1 to 2 feet high,



Fig. 50 COMMON HORSETAIL (*Equisetum arvense*). Left: A sterile branched stalk, the one most commonly observed. Right: Fertile stalk with its terminal cone and loose sheath-like collar at nodes.



Fig. 51 COMMON SCOURING RUSH (*Equisetum hiemale*). Left: Base in ing one upright stem and a portion of the long rhizome. Solid l portions grow underground. Center: Top of same plant incl cones and branches. Right: SMOOTH SCOURING RUSH (*Equi lacvigatum*). Fertile branch with pointed cone and flared sheat nodes.

usually unbranched, pale green. Sheath longer than broad, flaring open, teeth of the sheath deciduous, resulting in a smooth border to the sheath when they fall. Cones ½ to 1 inch long borne at the ends of the stems.

Sometimes called Braun's Scouring Rush. This species is found in the Sierra Nevada at such p as Granite Creek and Round dow in Sequoia National Park, the Merced River in Yosemite V and northward to British Colu eastward to the Great Lakes, M chusetts, Virginia and Ge southward to Mexico and ( mala.

## ANSAS SCOURING RUSH

**uisetum kansanum Schaffner**
**(Fig. 52)**

ilar in appearance to *E. laeviga-*
ecause the sheath flares open.
species is not evergreen and
ne is rounded at its tip.
o known as the Kansas Horse-
Least common of the species
in the Sierra, it has been col-
by Carl Sharsmith near Arch
Yosemite. It is reported from
lls, Sequoia National Park and
wn in a few widely scattered
from Ohio westward to British
bia and in Texas.

## SELAGINELLACEAE
## SELAGINELLA FAMILY
SELAGINELLA

creeping branching herbac-
plants, usually on soil, having
ppearance of moss. Stems cov-
with small uniform leaves
overlap. Leaves spirally at-
d to the stem. Reproduction by
s borne in cones, the cones usu-
uadrangular whereas the vege-
stems are not quadrangular
lindrical.
vegetative leaves and spore
g leaves are rather similar in
rance. Cones, therefore, re-
e portions of a leafy stem. For
ason, and because cones are
rne on stalks, one must exam-
plant carefully in order to see
Cones produce two types of
: microspores, small, numer-
sually red or orange, and meg-
s, 4 per sporangium, frequent-
low. Margins of leaves and
hylls may bear hair-like cilia,
e leaf apex often terminates in
a soft bristle, white or trans-

only genus in the family, it is

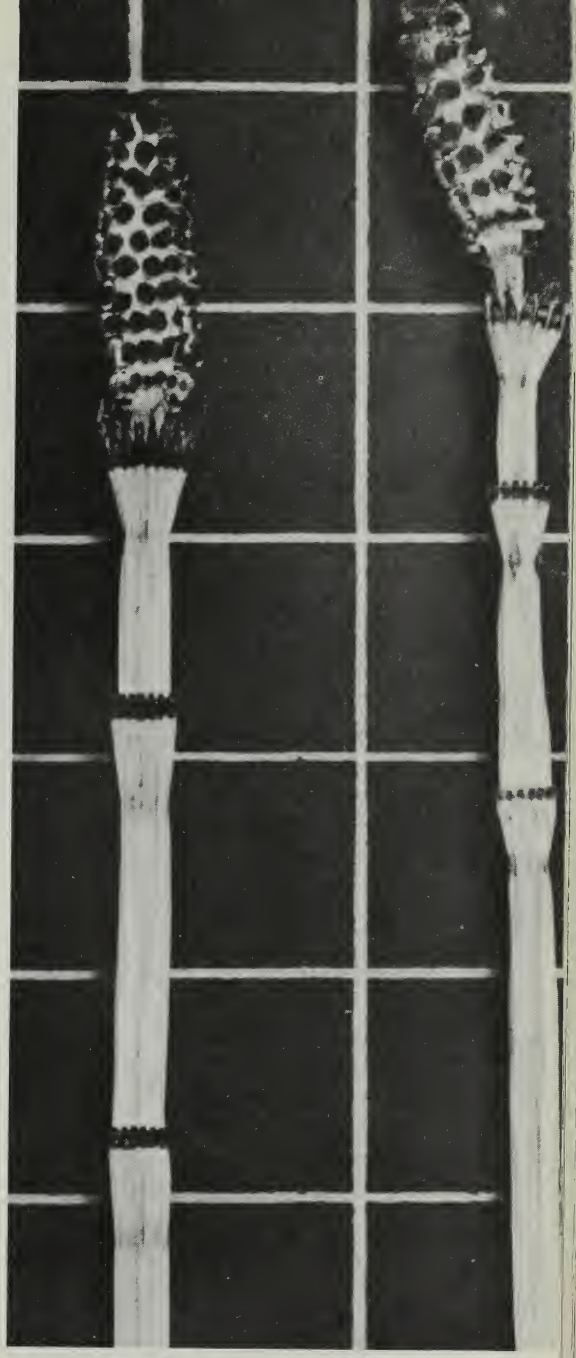


Fig. 52 KANSAS SCOURING RUSH (*Equisetum kansanum*). Fertile branch with rounded cone and flared sheaths at nodes.

widely distributed throughout the world, and is more common in the tropics and places of high rainfall. Species from Texas and other areas may be bought in variety stores as the Resurrection Plant, which appear dead and are tightly curled, but if put into a saucer of water overni they open and become bright gr Our species are not usually suit for gardens or as potted h plants. They will stay for short iods if kept in moist soil. Inve quart jar over them for best res

KEY TO THE SPECIES:

Branches somewhat dorsiventral, leaves of the under ranks largest, obliquely imbricate, foothills to 6000 feet elevation .....*S. ha*
Branches not dorsiventral, leaves uniform, equally distributed on all sides, 8,000 to 11,000 feet elevation .....*S. wa*

## HANSEN'S SELAGINELLA

### Selaginella hansenii Hieron. (Fig. 53)

S. ruprestris var. hanseni

Prostrate stems 2 to 10 inches long, stems branch once, rarely 2 or 3 times, strongly dorsiventral with leaves obliquely imbricate. Leaves lanceolate, terminating in a seta which is about 1/32 inch long, white to transparent. Leaf margins are lined with 6 to 18 cilia on each side. In cones the sporophylls broader than leaves, almost triangular, sporangia attached at the megaspores yellow, microsp orange.

Forms mats on rocky place lower elevations in the Sierra vada from 1,000 to 6,000 feet vation. Common in the foo this species may be observe the base of the cliffs on the slope on the north side of Yos Valley. It extends from Fresno C to Mount Shasta.

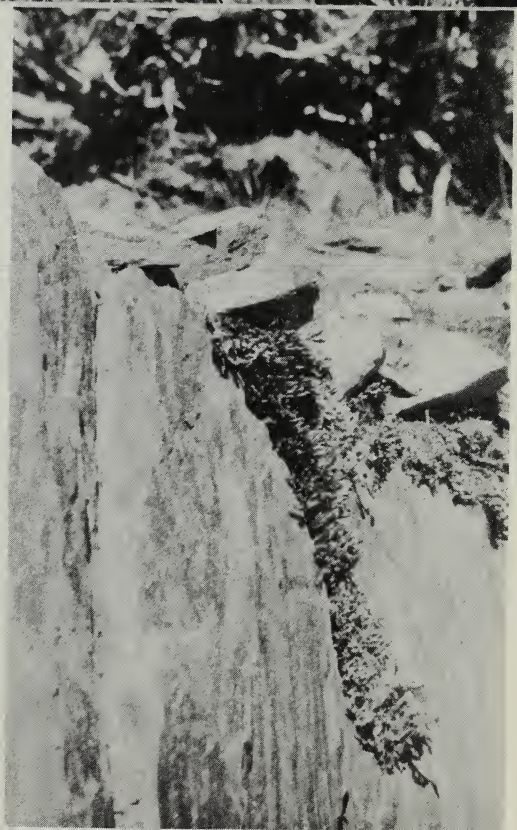
## ALPINE SELAGINELLA

### Selaginella watsonii Underw. (Fig. 53)

Creeping stems 1 to 12 inches long with a few short branches that form mats. Lanceolate leaves are of equal length on upper and lower sides of the stem. Each leaf has as many as 9 cilia or none, ending with a short, greenish-yellow seta. Cones quadrangular ½ to 1 inch long in which sporophylls resemble leaves except that sporophylls are bro almost triangular.

Although this species has o occasions been found at 6,00 elevation, it is usually found 10,000 to 13,000 feet. Known alpine regions on some of the h mountains in the Sierra from places as Fairview Dome, Mountain, Mt. Lyell Cirque, Kuna Crest in Yosemite. It wa collected in Utah and has also recorded from Nevada, Oregon Montana.





3 HANSEN'S SELAGINELLA (*Selaginella hansenii*). Upper: Found at low elevations. White arrows point to quadrangular cones. Lower: ALPINE SELAGINELLA (*Selaginella watsonii*). Growing in cracks of mica shist rocks above 10,000 feet elevation.

## ISOETACEAE

## QUILLWORT FAMILY

### ISOETES

Perennial plants either submerged, amphibious or terrestrial. Stem forms a condensed 2 or 3-lobed corm; numerous roots branch dichotomously. Leaves are broad at base, tapering to an awl-like apex, 3 or 4-angled in cross-section appearing hollow, but actually having 4 longitudinal rows of air chambers. Many leaves, ultimately becoming sporophylls which bear microspores or megaspores on their inner side at the base of the leaf. Sporangia, flattened on one side, are never larger than about ⅛ inch in diameter and may or may not be covered with a membr called a velum. According to one microsporangium proc 150,000 to 300,000 microspores one megasporangium produce to 300 megaspores. One leaf bear only one of these kin spores. The sculpturing of the angia walls by various sp ridges and reticulations is imp in the classification of the sp

This is the only genus in the ily and contains about 60 sp with worldwide distribution a ing to Abrams.

### KEY TO THE SPECIES:

Submerged aquatic, 2-lobed corm ..... *I. bo*
Terrestrial in damp places, 3-lobed corm ..... *I. n*

### BOLANDER'S QUILLWORT

**Isoetes bolanderi Englm. (Fig. 54, 55)**

Corm 2-lobed, 5 to 20 leaves, 2 to 6 inches long, tapering like a quill, hence the common name. Megaspores marked with minute spines and wrinkles, microspores spiny.

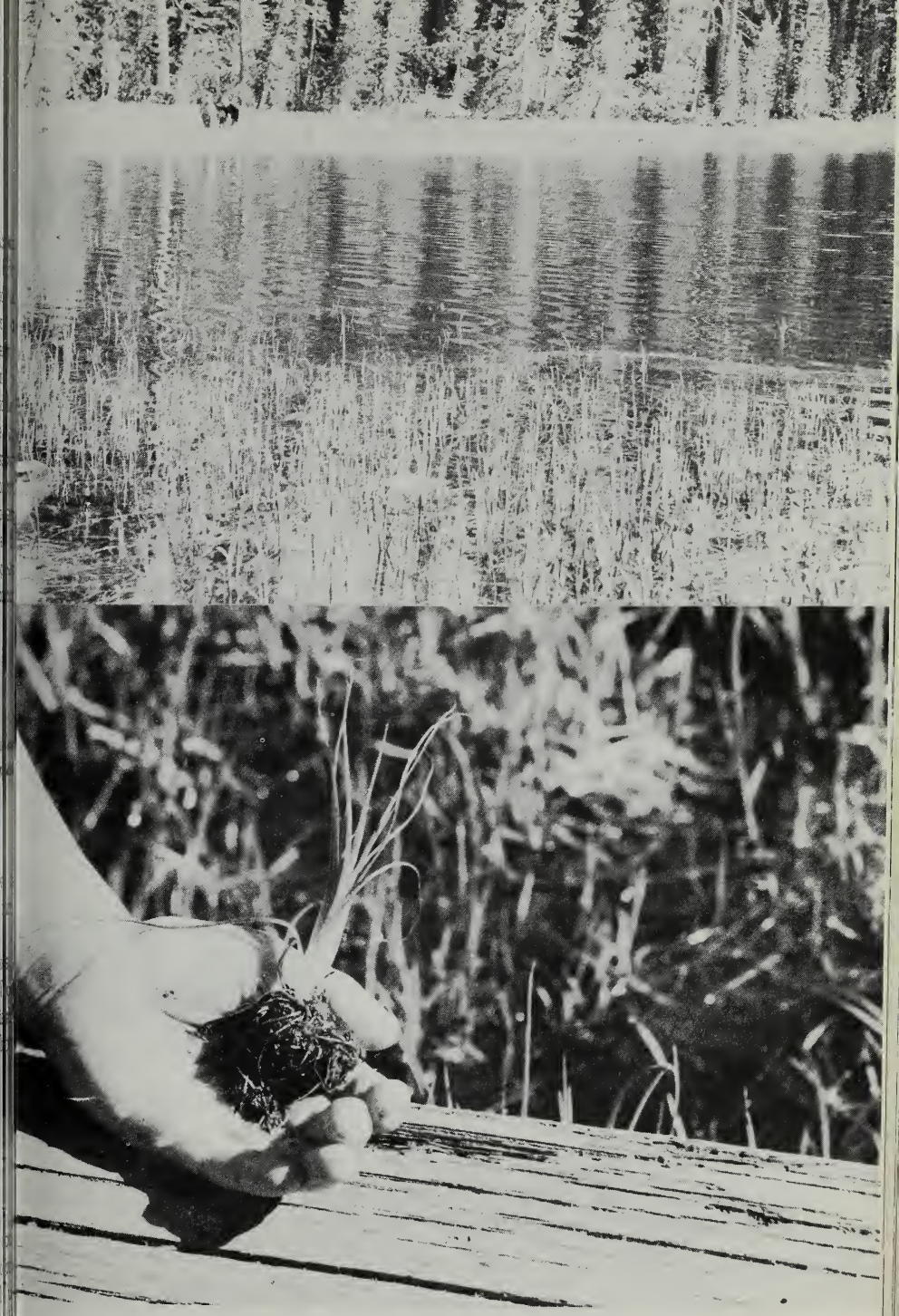
In shallow ponds and lakes 5,000 to 10,000 feet elevation Sierra Nevada including places as Siesta Lake, Dog Lak ponds in many meadows in Y ite. It is also known from Briti lumbia to Wyoming, in Col and Arizona.

### NUTTALL'S QUILLWORT

**Isoetes nuttallii A. Br. (Fig. 55)**

Corm 3-lobed, 15 to 60 leaves per plant, leaves 3 or 4 inches long, slender. Megaspores variable in size, smooth or warty; microspores brown, covered with spinelike papillae.

A terrestrial species found banks of streams, or more c in the Sierras in shallow soil the mist of waterfalls. Distr throughout California, C Washington, Idaho, and Lowe fornia.



4 BOLANDER'S QUILLWORT (*Isoetes bolanderi*). Upper: Growing in a typical shallow lake of the Sierra where water is no deeper than four feet. Lower: Close-up of this species from the above lake.

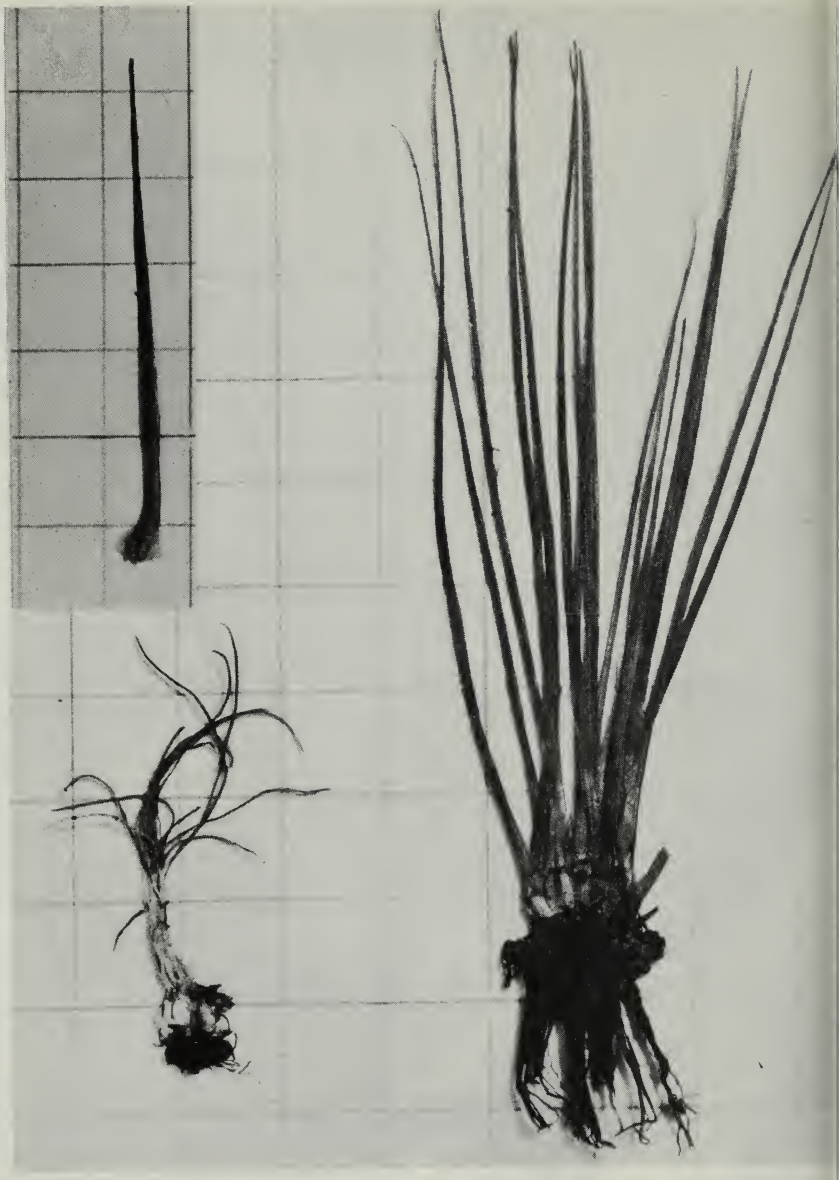


Fig. 55 Lower left: NUTTALL'S QUILLWORT (*Isoetes nuttallii*). Swolle
bases contain sporangia. This species grows in the mist of wate
with its roots in soil. Right: BOLANDER'S QUILLWORT (
***bolanderi***). Showing comparative size to the first species. U
insert: One leaf or sporophyll of the latter species with its
angium at the base.

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